# Upper Touchet
# Vegetation Management Project

## (Draft) Silviculture Report

**Prepared by:**

Eric Pfeifer
Silviculturist
February 2019

*As Modified by Deanna Engelmann*
*(Clarifications in Response to Comments Only)*

**For**:

Walla Walla Ranger District
Umatilla National Forest

U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TTY). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW., Washington, DC 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TTY). USDA is an equal opportunity provider and employer.

NOTE ON TRANSITION BETWEEN RESPONSIBLE SILVICULTURISTS WORKING ON THE PROJECT

Upper Touchet Draft EA Transition Memo 29 May 2019

To disclose what occurred for the draft EA of Upper Touchet, in March 20109, after the furlough, the previous Silviculturist moved to his new duty station...Prior to that, he and his team in Silviculture conducted a thorough analysis of field and digital data including references for peer-reviewed literature and site-specific observations. These data sources provided him with the context to prepare an Upper Touchet Silviculture report that had some information originally derived from the Sunrise EIS. He also was involved in the comments process which gave the agency insight into the views of interested members of the public. His report was detailed in that it covered the genesis and impacts expected from Alternative D, the most impactful alternative, as well as the potential impacts of a changing climate on the area. Files provided to me are all part of the project record and included the references, the report, the field data sheets, and spreadsheets that covered the range of variation analysis necessary under policy to determine if this project is subject to the Eastside Screens Regional Forester memo from 1995.

In moving forward with this EA assignment, I continued the spreadsheet analysis of RV to include the expected change in tree species, density, and structure for Alternatives A and B. I then wrote a thorough but brief analysis of the alternatives and their cumulative impacts and provided references that I cited in the Vegetation section of the EA. No additional field data was collected beyond the previous Silviculturist's original assessments to interpret the expected changes under all alternatives.

Jack K. Comish
Silviculture Forester
Walla Walla and Pomeroy Ranger Districts

# Table of Contents

**List of Tables**



**List of Figures**

# Summary

This section summarizes the direct, indirect, and cumulative effects of the project on forest vegetation resources, with the intention that it can be directly transferred to the Environmental Analysis project document.

## Direct, Indirect, and Cumulative Effects

### *Forest Vegetation Resources*

The proposed action would result in the mortality and/or removal of some live conifer trees, and the removal of hazardous snags and downed logs. Live conifer trees that are removed through project activities would be targeted to improve stand health, reduce excess fuels, reduce physical hazards to ski area users, and to create some glade skiing. This would also decrease the risk of density related mortality, insect & disease outbreaks, and risk for high-severity fire events within the project area. The stand basal area for conifer forest would vary between 80$ft^2$ - 120$ft^2$ after project activities, per the Forest Plan. Growth rates would increase for trees left within activity units. The trees that remain would have a minimal risk of being blown over or damaged by wind. Overall vegetation composition, distribution, and abundance in stands would follow natural succession patterns. Long-term benefits are expected in the project area as a result of project activities. The project would lower fuel loading and/or susceptibility to insect and disease disturbances across approximately 3000 acres, or 6.5 percent of the 47,000-acre vegetation analysis area. Vertical structure would be altered on no more than 600 acres, or 1.7 percent of the vegetation analysis area.

Past vegetation and fuels management actions in the analysis area had effects that persists on the landscape in the existing array of structural stages and susceptibility levels. In most cases, these effects have contributed in a positive way to the project purpose and need by reducing density and regenerating species resistant to many insect and diseases. At the scale of the vegetation analysis area, the Upper Touchet would have minor effects, augmenting the positive effects of past projects. Effects from present and reasonably foreseeable future tree-cutting activities that might amplify, augment, or counteract effects from the Upper Touchet project are expected to be negligible at the scale of the vegetation analysis area.

# Introduction

This report describes the context, methodology, and findings pertaining to the vegetation and carbon-related issues chosen for the Upper Touchet Vegetation and Fuels Management Project ("Upper Touchet Project") environmental analysis. Findings include a discussion of cause-effect relationships between the analysis alternatives and issue measures/indicators, and consistency of the alternatives with applicable laws, rules, and regulations.

Issues for the Project were identified for detailed analysis following scoping. Issues are analyzed to describe possible environmental effects, determine consistency to relevant to laws, rules, and regulations, and to allow comparison between management alternatives with respect to the project purpose and need. All issues pertinent to forest vegetation are described in this report as a cause-effect relationship, wherein the activities are considered in terms of their possible direct, indirect, and cumulative effects on forest vegetation.

## Issue Measures and Indicators

The issues approved for analysis for the Project are analyzed in terms of measures and indicators that describe the magnitude, spatial and temporal extent, likelihood, and speed of effects (Table 1). These measures and indicators enable four important elements of environmental planning: comparison of effects between alternatives, disclosure of possible effects to the general public, identification of possible measures to mitigate for or reduce undesired outcomes, and a reasoned decision. Most measures and indicators utilized for this report are quantitative, except for likelihood, which is not feasible to quantify with a reasonable degree of accuracy or an estimated error. For such cases, project effects on certain measures and indicators will be considered in qualitative terms using professional judgement.

**Table 1. Issues, Measures, and Indicators used in the Upper Touchet project environmental effects analysis for forest vegetation.**

| **Issue**<br>*The proposed activities, in whole or in part, may:* | **Measures / Indicators** | | | | |
|---|---|---|---|---|---|
| | **Magnitude**<br>*(amount of change of a value)* | **Speed** | **Spatial Extent** | **Temporal Extent / Duration** | **Likelihood** |
| Reduce susceptibility of forest vegetation to attack by root disease, defoliating insects, and bark beetles. | Amount (acres) and proportion of forested biophysical environment within the project analysis area | Immediately following implementation, which is expected to occur over a 1 to 5-year period. | Project vegetation analysis area | Short (1-10 yrs)<br>Mid-term (10-30 yrs) | Near-certain / Likely / Not likely / Highly unlikely |
| Alter the distribution of late/old forest structural stages | Amount (acres) and proportion of structural stages across forested biophysical environment within the project analysis area | Immediately following implementation, which is expected to occur over a 1 to 5-year period. | Project vegetation analysis area | Short (1-10 yrs)<br>Mid-term (10-30 yrs) | Near-certain / Likely / Not likely / Highly unlikely |
| Alter Net Ecosystem Productivity (carbon balance) | Tons carbon dioxide | Immediately following project implementation, and continuing at variable speeds over a 50-year period.. | Project vegetation analysis area. | Short (1-10 yrs)<br>Mid-term (10-30 yrs) | Near-certain / Likely / Not likely / Highly unlikely |

# Analysis Area

The Upper Touchet forest vegetation analysis area is defined in this report as all Umatilla National Forest lands classified as dry, moist, or cold upland forest (Powell et al. 2007) within the 46,492-acre area indicated in Figure 1. The size and location of the analysis area was developed with consideration of forest vegetation resources, as well as other resources and resource issues substantially related to forest vegetation: wildlife habitat, aquatic resources, recreation, and fire/fuels. The precise locations of management activities included in the action alternatives occur within a broader landscape that affects and is affected by what happens within the smaller activity sites. As a result, the analysis area is geographically and temporally expansive enough to capture other resource considerations such as wildlife habitat connectivity. The management direction of the forest vegetation analysis area is described below. A rationale for the spatial and temporal context utilized for this analysis is discussed later in the methodology section.

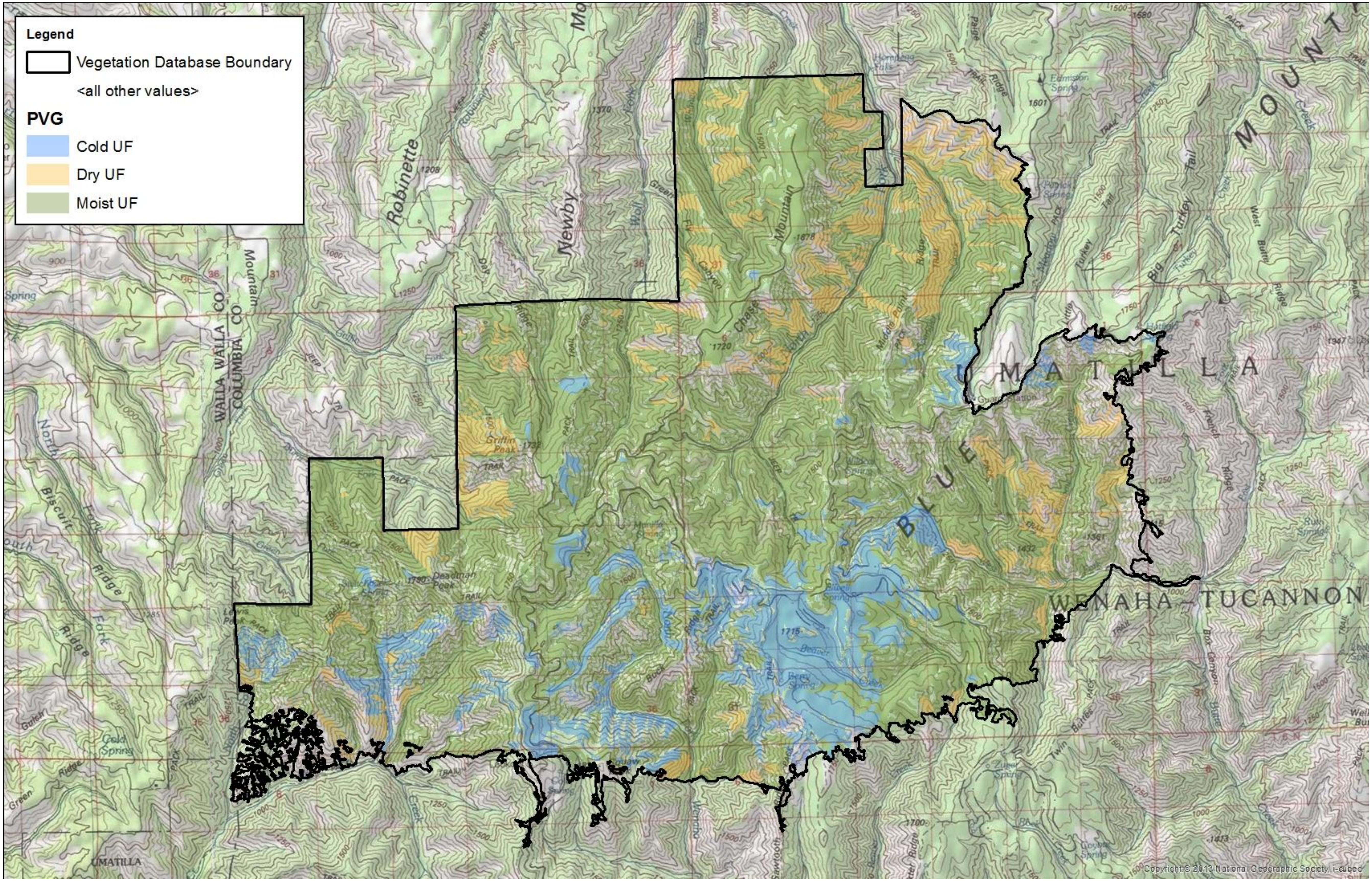
## Management Direction

The most important factor influencing whether or how a forested area might be affected during implementation of an action alternative is management direction from the 1990 Land and Resource Management Plan for the Umatilla National Forest (Forest Plan), as amended (USDA Forest Service 1990). The forest vegetation analysis area includes several Forest Plan Management Areas, with additional designation for Riparian Habitat Conservation Areas (RHCAs) adjoining rivers, streams, and other wetlands. This Forest-wide riparian habitat allocation is referred to as PACFISH (USDA Forest Service 1995, USDI Bureau of Land Management 1995). At present (November 2018), a final decision to adopt the revised Forest Plan for the Umatilla National Forest has not been issued, but is imminent. This report will assess project consistency with both the 1990 and 2019 Forest Plan, and references herein to the “Forest Plan” will refer to both.

The management direction provided by the Forest Plan makes up the framework within which project planning and activities take place. The Plan defines Forest-wide and management area goals and management standards that guide project activities toward achieving a desired future condition for the given management area and, collectively, for the Forest. Forest-wide goals, objectives, and a description of the desired future condition constitute the first portion of Chapter 4 of the Forest Plan, which is included with this report as Appendix D. The Forest Plan also provides guidance concerning potential projects and project limitations, including assumptions about the appropriate vegetation management practices for timber sale projects and best management practices to protect water quality for all Forest management activities. On-the-ground project analysis then verifies the appropriateness of the assumptions. Within this guidance, projects are developed which most efficiently and effectively accomplish management goals and objectives.

Project design features, management requirements, and other implementation considerations for the forest vegetation silvicultural activities are guided by the Land and Resource Management Plan for the Umatilla National Forest. Additional forest vegetation management direction is provided by amendments implemented after Forest Plan approval in 1990, including two amendments in particular: “Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales” (USDA Forest Service 1995; also known as Eastside Screens); and “Interim Strategies for Managing Anadromous Fish-Producing Watersheds on Federal Lands in Eastern Oregon and Washington, Idaho and Portions of California” (USDA Forest Service and USDI Bureau of Land Management 1995; also known as PACFISH). The Eastside Screens Forest Plan amendment focuses on the potential impact of timber sales on riparian habitat, historical vegetation patterns, and wildlife habitat connectivity (USDA Forest Service 1994, USDA Forest Service 1995). The PACFISH Forest Plan amendment establishes

**Figure 1. Vegetation Analysis Area for the Upper Touchet Project. The geographic vicinity of the project area is found in the Environmental Assesment. Non-forest potential vegetation groups are not colored included in the Analysis, and are not colored in this figure.**



management direction designed to arrest and reverse declines in anadromous fish habitat (USDA Forest Service and USDI Bureau of Land Management 1995).

## *Management Area Goals, Desired Conditions, and Allowable Activities*

The Umatilla Forest Plan provides management direction by: 1) describing goals, desired conditions and resource emphasis for allocated Management Areas; 2) allowing or restricting specific activities (e.g. timber harvest) within Management Areas; 3) and directing allowable activities through the establishment of Standards and/or Guides. Management Areas provide the multiple-use direction for managing specific areas of land. Each Management Area is described in the Forest Plan as a goal statement which reflects the expected results for a Forest resource, activity, or land area. Each Management Area also has a desired future condition statement associated with goals for the area. Management Areas respond to issues, concerns and opportunities, appropriate laws, regulations, existing direction, land capabilities, and professional judgment described in the Forest Plan. Management areas identify activities and where each will take place during implementation of the Forest Plan.

The Umatilla National Forest Land and Resource Management Plan (Forest Plan, 1990), as amended, recognizes the following project related forest management goals (pp. 4-1 – 4-3):

- Provide land and resource management that achieves a more healthy and productive forest and assists in supplying lands, resources, uses, and values which meet local, regional, and national social and economic needs.
- Provide for a broad spectrum of recreation opportunities and experiences and a variety of recreation settings on the National Forest for Forest recreationists.
- Provide attractive natural to near-natural settings for forest users along important highways, roads, trails and in and around developed and primitive sites.
- Provide and manage administrative facilities sufficient to serve the public and accomplish land and resource management and protection objectives of the forest.
- Provide and execute a fire protection and fire use program that is…responsive to land and resource management goals.

Chapter 4 is the heart of the Forest Plan and contains management area goals, desired conditions, direction which the Forest has established for plan implementation. The Forest objectives include the projected resource outputs, activities, and budget necessary to achieve the goals. Management area direction takes precedence over Forest-wide direction, and both are included in Chapter 4 of the Plan. Desired future conditions are described for the Forest as a whole, and for each Management Area. Activities considered for the Upper Touchet project would occur in one or more of the following Management Areas: A3 Viewshed 1; A4 Viewshed 2; A6 Developed Recreation; E2 Timber and Big Game. Timber harvest is not allowed by the Forest Plan in some Management Areas, but none of the activities considered for the Upper Touchet project are expressly prohibited for the Management Areas in which they would occur.

## *Forest-wide Standards and Guidelines*

Forest-wide standards and guidelines guide implementation of management actions and pertain to all National Forest System lands located within the Umatilla National Forest, including the Upper Touchet project area. Consistency of the project action alternatives with Forest Plan Standards and Guidelines is reported in the last section of this report.

## Range of Variation

The Range of Variation (RV) analytical technique is used to evaluate existing and future conditions for three vegetation components: species composition, forest structure, and stand density. It is the basis upon which a qualitative need for action pertaining to vegetation manipulation is displayed.

**Incorporation by Reference**: A Umatilla National Forest white paper entitled "Range of Variation Recommendations for Dry, Moist, and Cold Forests" (Powell 2014b) is incorporated by reference for the Upper Touchet forest vegetation analysis. The white paper discusses the following items related to HRV: concepts and principles; ecosystem variation; RV as an analysis tool; RV as a baseline; RV and climate change; ecosystem components used with an RV analysis; project analysis and RV; glossary; an extensive reference section (literature cited), and a series of figures and tables relating to the RV analytical technique. Since the 58-page Range of Variation white paper (Powell 2014b) is incorporated by reference, most material from the white paper will not be repeated in this specialist report.

## Existing and Desired Conditions

The combination of geology and topography in and around the Project Analysis area currently produces a distinctive mosaic of dense, heavily forested slopes interspersed with open herblands. Volcanic ash soils of varying depth contribute to productive forest stands and herblands that provide forage and browse.

The underlying geological substrate of the northern Blue Mountains has interacted with climate, native and invasive fauna, and human beings to produce the vegetation conditions found in the vegetation analysis area today. Detailed descriptions of these interactions and processes specific to the analysis area are described in Powell (2000) and the Interior Columbia Basis Ecosystem Management Project (Quigley et al., 1997) for the sub-watersheds in and around the project area. The manifestations of these biophysical processes for forest vegetation is represented in this report by potential vegetation, structural stages, and density classes.

### *Potential Vegetation*

Plant communities within the forest vegetation analysis area that would likely develop along successional pathways in the absence of disturbance are characterized using potential vegetation groups (PVG), a higher-level taxonomic unit in a hierarchy of potential vegetation types (Powell et al. 2007). PVGs are named for a predominant or controlling temperature/moisture regime and topographic position (e.g., upland or riparian sites). The potential vegetation groups of the project planning area is described below in Table 2. The historical range of variability analysis for forest vegetation structural stages provided later in this report stratifies species cover type, structural stage, and density classes among Potential Vegetation Groups. Table 2 summarizes the PVG composition of the Vegetation Analysis area, and shows that the predominant PVG is dry upland forest (35%), followed by moist upland forest (31%), and cold upland forest (5%). Remaining potential vegetation groups are composed of non-forest flora (herbaceous plants, shrubs, and small patches of deciduous trees)

**Table 2 - Potential upland forest vegetation groups for the Vegetation Analysis area**

| PVG Code | Potential Vegetation Group Description | Acres | Percent of Total |
|---|---|---|---|

| PVG Code | Potential Vegetation Group Description | Acres | Percent of Total |
|---|---|---|---|
| Cold UF | Cold Upland Forest | 4,954 | 14 |
| Dry UF | Dry Upland Forest | 4,436 | 12 |
| Moist UF | Moist Upland Forest | 26,348 | 74 |

## *Susceptibility to insect and disease disturbances*

Forest vegetation in the project area currently exhibits variable susceptibility to damage and/or mortality caused by native and non-native insects and pathogenic fungi. Susceptibility is related to vegetation density, species composition, and vertical structure (Schmitt 1999, Schmitt and Powell 2005, Schmitt and Scott 1993; Scott 1996), and is also exacerbated by environmental stresses (Kolb et al. 2016). Existing and recent conditions relating to damage and mortality caused by forest insects and diseases is summarized by Spiegel (2017) and McWilliams (2017) respectively (Appendix A). Susceptibility ratings were not specified for the Upper Touchet project, but overall changes in susceptibility were quantified for the effects analysis later in this report.

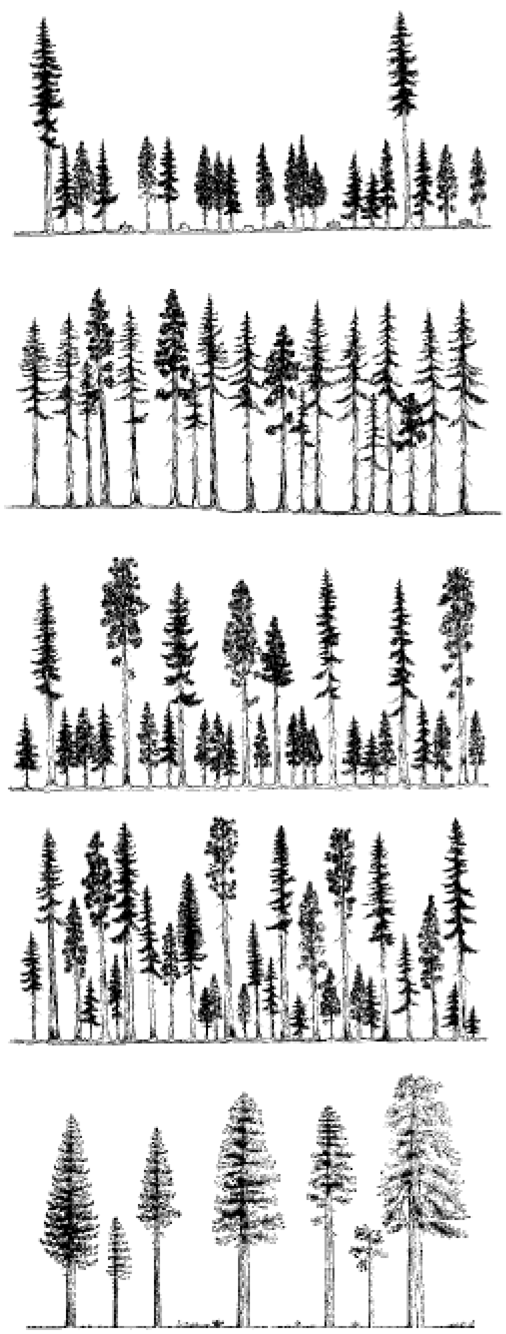
## *Forest Structural Stages*

Well-distributed and diverse mosaics of forest structural stages creates ranges of conditions that are ecologically resilient and sustainable (Stine et al. 2014). For the Upper Touchet project, forest structural stage definitions are defined using standard classifications described in Oliver and Larson (1996) and O'Hara (1996), and illustrated in Figure 2. Table 3 displays the existing conditions for forest structural stages within each upland forest potential vegetation group for the project area.

**Table 3. Forest structural stage extent and distribution for forest Potential Vegetation Groups (PVGs) within the Upper Touchet project Vegetation Analysis area.**

| | Existing Conditions | | Reference Conditions | | | |
|---|---|---|---|---|---|---|
| | | | Percent of PVG | | Acres | |
| | Acres | % of total | Low | High | Low | High |
| Dry Upland Forest | | | | | | |
| Stand Initiation | 1642 | 37 | 15 | 30 | 665 | 1,331 |
| Stem Exclusion | 288 | 6 | 10 | 20 | 444 | 887 |
| Understory Reinitiation | 564 | 13 | 0 | 5 | 0 | 222 |
| Old Forest Single-Stratum | 471 | 11 | 40 | 65 | 1,774 | 2,883 |
| Old Forest Multi-Strata | 1,471 | 33 | 1 | 15 | 44 | 665 |
| Total | 4,436 | | | | | |
| Moist Upland Forest | | | | | | |
| Stand Initiation | 4486 | 17 | 20 | 30 | 5,270 | 7,904 |
| Stem Exclusion | 2,517 | 10 | 20 | 30 | 5,270 | 7,904 |
| Understory Reinitiation | 3,352 | 13 | 15 | 25 | 3,952 | 6,587 |
| Old Forest Single-Stratum | 4,688 | 18 | 10 | 20 | 2,635 | 5,270 |
| Old Forest Multi-Strata | 11,304 | 43 | 15 | 20 | 3,952 | 5,270 |
| Total | 26,348 | | | | | |
| Cold Upland Forest | | | | | | |
| Stand Initiation | 287 | 6 | 20 | 45 | 991 | 2,229 |
| Stem Exclusion | 835 | 17 | 15 | 30 | 743 | 1,486 |
| Understory Reinitiation | 1,149 | 23 | 10 | 25 | 495 | 1,238 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Old Forest Single-Stratum | 942 | 19 | 5 | 20 | 248 | 991 |
| Old Forest Multi-Strata | 1,740 | 35 | 10 | 25 | 495 | 1,238 |
| Total | 4,954 | | | | | |



**Stand Initiation (SI).** Following a stand-replacing disturbance such as wildfire or timber harvest, growing space is occupied rapidly by vegetation that either survives the disturbance or colonizes the area. Survivors literally survive the disturbance above ground, or initiate growth from their underground roots or from seeds stored on-site. Colonizers disperse seed into disturbed areas, the seed germinates, and then new seedlings establish and develop. A single canopy stratum of tree seedlings and saplings is present in this class.

**Stem Exclusion (SECC or SEOC).** In this stage of development, vigorous, fast-growing trees that compete strongly for available light and moisture occupy the growing space. Because trees are tall and reduce sunlight, understory plants (including smaller trees) are shaded and grow more slowly. Species that need sunlight usually die; shrubs and herbs may become dormant. In this class, establishment of new trees is precluded by a lack of sunlight (**stem exclusion closed canopy**) or of moisture (**stem exclusion open canopy**).

**Understory Reinitiation (UR).** As a forest develops, new age classes of trees (cohorts) establish as the overstory trees die or are thinned and no longer fully occupy growing space. Regrowth of understory vegetation then occurs, and trees begin to develop in vertical layers (canopy stratification). This class consists of a sparse to moderately dense overstory with small trees underneath.

**Young Forest Multi Strata (YFMS).** In this stage of forest development, three or more tree layers are present as a result of canopy differentiation or because new cohorts of trees got established. This class consists of a broken or discontinuous overstory layer with a mix of tree sizes present (large trees are absent or scarce); it provides high vertical and horizontal diversity. This class is also referred to as "multi-stratum, without large trees" (USDA Forest Service 1995).

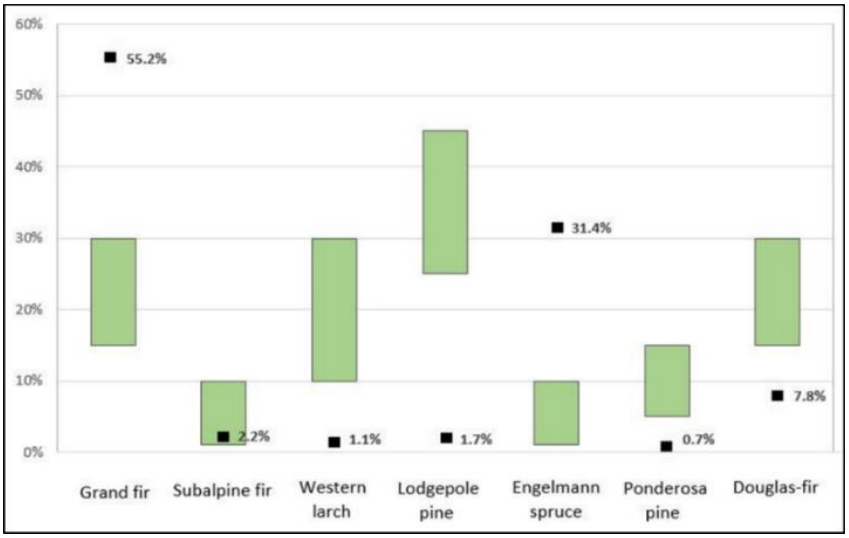
**Old Forest (OFSS or OFMS).** Many age classes and vegetation layers mark this structural class and it usually contains large, old trees. Decaying fallen trees may also be present that leave a discontinuous overstory canopy. The diagram shows a single-layer stand of ponderosa pine that evolved with high frequency, low-intensity fire (**old forest single stratum**). On cool moist sites without recurring underburns, multi-layer stands with large trees in the uppermost stratum may be present (**old forest multi strata**).

**Figure 2. Forest vegetation structural stages assessed for the Upper Touchet project, with the exception of Young Forest Multi Strata, which was combined with the Understory Reinitiation stage for this report.**

## Species Composition

Tree species composition is evaluated by using forest cover types, which are named for the tree species with the greatest percentage of stocking and occurrence in a stand. The grand fir cover type, for example, would contain a greater percentage of grand fir than other tree species but would not be expected to have a pure composition of grand fir. Graph 1 below displays the existing conditions for species composition compared to RV Reference Conditions within moist upland forest potential vegetation group for the project area.

**Graph 1 Species Distribution In Moist Upland Forest PVG For The Vegetation Analysis Area. Green = Reference Conditions, Black = Current Conditions**




## Density

Forest density is a measure of the amount of tree vegetation on a unit of land. It can be expressed as basal area (BA), stand density index (SDI) (Reineke1933), or by using other parameters. Stocking is the proportion that any particular measurement of stand density bears to a standard expressed in the same units.

Local, site-specific stocking guidelines (Cochran et al. 1994, Powell 1999) are used to analyze stand density levels to infer whether they are stocked with trees at a low, moderate, or high level. Forests with high density levels are in a self-thinning zone where trees aggressively compete with each other for moisture, sunlight, and nutrients. Forests in the self-thinning zone eventually experience mortality as crowded trees die from competition, or as they are killed by insects or diseases that seek out stressed trees (Cochran et al. 1994, Powell 1999). By using the stocking guidelines in conjunction with potential vegetation groups, it is possible to determine the number of acres in each density class. Stocking guides also provide local, site-specific density ranges to help guide and align current conditions to within range of variation recommendations (desired conditions). Assessing the departure of density classes from current to desired conditions and using stocking guidelines can help quantify the level of density management treatments using a variety of metrics, such as trees per acre or basal area per acre.

The table below displays reference conditions for density by PVG, of which certain stages are exceeding or have diminished from their historical ranges. In the Moist Upland PVG within the analysis area, high and low density stands are overrepresented, while moderate density is underrepresented. In the Dry

Upland PVG, high density stands are overrepresented, while moderate density is underrepresented. In the Cold Upland PVG, low density stands are overrepresented, while moderate density is underrepresented. See Silviculture Report in the project record for more information on stocking standards and stocking guidelines.

| PVG | Density of basal area in ft2/ac at 10" QMD | Reference Conditions % | Current Conditions % | Current Acres | Alt A % | Alt A Acres | Alt B % | Alt B Acres | Alt D % | Alt D Acres |
|---|---|---|---|---|---|---|---|---|---|---|
| Moist UF | High >150 | 15-30 | 52 | 13756 | 41 | 10905 | 41 | 10905 | 42 | 11120 |
| | Mod 100-150 | 25-60 | 3 | 760 | 3 | 760 | 3 | 760 | 3 | 760 |
| | Low <100 | 20-40 | 45 | 11819 | 56 | 14670 | 56 | 14670 | 55 | 14455 |
| Dry UF | High >85 | 5-15 | 40 | 1791 | 36 | 1588 | 36 | 1588 | 36 | 1589 |
| | Mod 55-85 | 15-30 | 5 | 215 | 5 | 215 | 5 | 215 | 5 | 215 |
| | Low <55 | 40-85 | 55 | 2430 | 59 | 2633 | 59 | 2633 | 59 | 2632 |
| Cold UF | High >120 | 25-60 | 56 | 2783 | 55 | 2717 | 55 | 2717 | 53 | 2642 |
| | Mod 80-120 | 20-40 | 2 | 121 | 2 | 121 | 2 | 121 | 2 | 121 |
| | Low <80 | 15-35 | 41 | 2050 | 43 | 2116 | 43 | 2116 | 44 | 2191 |

The RV analysis shows a deviation in structural stages, species composition, and density for the existing vegetation within the Upper Touchet analysis area. Using an RV approach to help restore vegetation diversity means providing a full diversity of structural elements, densities, and species mix in variable configurations and quantities, which are better poised to maintain the dynamic patterns and processes that are essential to healthy ecosystems. A desirable landscape condition for the Upper Touchet project area is a diverse, heterogeneous vegetation mosaic more consistent with the range of variation identified for this project area.

## *Moist and Cold Upland Forest Management*

The Upper Touchet analysis area consists almost entirely of moist upland forest (74%) and cold upland forest (14%) potential vegetation groups. See Table 2.

**Incorporation by Reference**: A Umatilla National Forest white paper examines the effects of fire exclusion, and selective timber cutting on the integrity and sustainability of moist forest ecosystems, and it does so in the context of the Blue Mountains. The white paper, entitled "Active Management of Moist Forests in the Blue Mountains: Silvicultural Considerations" (Powell 2013), is incorporated by reference for this Upper Touchet forest vegetation analysis. The white paper discusses the following main topics related to moist-forest ecology and management: ecological setting; historical context; disturbance ecology concepts and processes in moist forest; influence of defoliating insects, bark beetles, forest fungus and disease; influence of selective timber cutting on moist-forest ecosystems; restoration of moist-forest ecosystems in the Blue Mountains; an extensive reference section (literature cited); and a series of figures and tables relating to moist-forest conditions and trends. Since the Moist Forests white paper (Powell 2013) is incorporated by reference, most material from the white paper will not be repeated in this specialist report. However, the following statements summarize the moist and cold upland forest management approach for the Upper Touchet project:

- Disturbances are fundamentally important in controlling landscape pattern and ecological function for moist-forest ecosystems.

- Disturbance, the primary initiator of plant succession, is important and integral for moist-forest ecosystems
- If landscapes can be maintained within RV, then they stand a good chance of maintaining their biological diversity and ecological integrity through time

# Environmental Consequences

## Methodology

The methodology utilized to assess and disclose the existing conditions, and direct, indirect, and cumulative effects of the activities included under the Project action alternatives incorporated a variety of information sources. Any particular assessment method is associated with a set of both strengths (accuracy and precision) and weaknesses (uncertainty and error). This analysis of effects on forest vegetation resources strives assessment and analytical strength through multiple lines of evidence (Goetz et al. 2012). The various methods utilized for this report are described in detail below, along with their associated strengths and weaknesses. The methods are characterized in terms relevant to successful implementation of the National Environmental Policy Act and associated case law, which require or recommend that disclosure of environmental effects include consideration and discussion of data validation and error, use of methods standard in the practice a field relevant to the resource being considered (in this case, forestry), and incomplete and/or unavailable information.

### *Data Sources and Consideration of Best Available Science*

The analysis information provided in this report was based on a variety of methodologies, models, and procedures, all of which are derived from scientific sources included in the References Cited section. Many of the analytical processes were based on local protocols and documentation for them is also included in the References Cited section.

Forest Service policy is that proposed projects must be consistent with the Forest Plan and show consideration of "best available science" (Dillard 2007). Science is not absolute nor irrefutable because much of what we know in a scientific context is constantly evolving (Moghissi et al. 2008). This means that what constitutes best available science might vary over time and across scientific disciplines (Dillard 2007). An objective of considering best available science is for both managers and scientists "to provide a meaningful context to scientific information so that its validity might be judged and therefore useful to the policymaker" (Moghissi et al. 2008).

In the context of Best Available Science, local protocols and similar information issued by government agencies is considered to be gray literature if not subjected to an independent peer review (Moghissi et al. 2008). Although many more sources were considered than what is included in the References Cited section of this report, the References Cited section demonstrates that Best Available Science was considered and discussed when completing The forest vegetation analysis.

The following data sources and methodologies were utilized to assess vegetation conditions across the Project Analysis area, and analyze the issues and indicators identified above. These sources and methods are commonly accepted techniques for forest vegetation assessment and provide the highest available accuracy and precision for analysis within reasonable, practical budgetary and technical constraints. Perhaps with the exception of a 100% sample, no sampling methodology provides a perfect representation for all forest attributes, and most methods are subject to statistical uncertainty, estimate errors, and in some cases, degree of bias. The methods below were utilized in order to provide the best possible representation of variables of interest given cost and time constraints, and represent commonly used and accepted methods and sampling intensities in the field of forestry. When known, limitations of each method are identified below and/or in the Environmental Consequences section.

- **Intensive Stand examinations**[1] provide ground-level information on individual tree and stand attributes. As with any sample of a larger population, the data collected using stand examination procedures are subject to statistical uncertainties and contain margins of error, which are described in output reports contained in the project record. In general, however, the stand conditions indicated by these data and assessed in the project analysis are suitably accurate for project-level analysis, and compatible with other assessment techniques (walk-through exams, aerial photos, etc.). The two phase stand examination procedure included field measurements and a Most-Similar Neighbor analysis (Appendix C), which involves interpolation of individual tree data to nearby similar stands with alternative measurements (ground reflectance and topographic data).

- **Field reconnaissance**. Extensive reconnaissance was performed by the author of this report throughout the Upper Touchet forest vegetation analysis area, during all seasons. Most harvest units were visited in person and received a walk-through examination. Many areas, including areas along Roads 40, 41, 43, and 44, were visited on dozens of occasions during all seasons over the course of several years. Visual observations on the ground were compared with other data sources for this report. Inconsistencies between ground observations and other data used in the analysis were rare. Where inconsistencies existed, on-the-ground observations were chosen.

- **Historical and scientific documents**. The Umatilla National Forest maintains an extensive collection of historical reference documents and the USDA Forest Service maintains a far more vast collection of scientific documents (http://www.treesearch.fs.fed.us), both of which were accessed to provide information on vegetation patterns and processes within the Upper Touchet forest vegetation analysis area. The uses of specific scientific or historical documents is noted within this document using in-text reference citations.

  In the context of Best Available Science, local protocols and similar information issued by government agencies is considered to be gray literature if not subjected to an independent peer review (Moghissi et al. 2008). Note that several of the local protocols (Powell 2013, 2014b) were not independently peer reviewed and therefore qualify as gray literature; four of the protocols (Powell 1999, 2010, 2014a; Powell et al. 2007) were peer reviewed and therefore constitute 'peer-reviewed science' (Moghissi et al. 2008).

  With few exceptions (primarily textbooks), sources contained in the References Cited section of this specialist report are available from the World Wide Web in digital form, and a Digital Object Identifier (doi) is included for these items whenever possible. [Digital object identifier is an international system used to uniquely identify, and link to, electronic journal articles.] All doi links pertain to formally published sources only; local analysis protocols, monitoring reports, and similar items will not have a doi.

  Note that a doi was provided for as many of the literature citations as possible to facilitate access to the item. Some of the doi links would allow free downloading of the electronic content in PDF format; other doi links will access a publisher's website (providing an abstract and other information about the work), but payment would be required to download the full work in PDF format. Note also that for books in the literature cited section, an International Standard Book Number (ISBN) is provided at the end of the citation. An ISBN number allows ready access to information about the book from Amazon.com or another bookseller, or the ISBN number can be entered in a web search engine (Google, etc.) to access the publisher's website for further information about the work.

[1] https://www.fs.fed.us/nrm/fsveg/

- **Professional expertise**. This report was prepared by a trained, experienced, professional forester with a Master of Science degree in Forest Resources from the University of Idaho, supplemented with considerable on-the-ground experience with the actions proposed for this project and their likely effects. Additional expertise and experience came from helpful reviews of this report, and the analysis of professional forest entomologists who visited the project area in 2017 and submitted reports of their findings (Appendix A).

- **Aerial photogrammetry.** Where field reconnaissance and stand examinations were not feasible due to inaccessible terrain, aerial photogrammetry was utilized to provide information on vegetation composition, structure, density, and susceptibility to insects and diseases. While aerial photos can provide excellent resolution of vegetation composition, density, and structure over large areas, some uncertainty exists with respect to sub-canopy vegetation (small trees, shrubs, etc.). This uncertainty has the general effect of underestimating the relative multi-cohort stands with a suppressed and/or sub-dominant canopy layer; however, examination of ground-based field data and professional experience in the area have led to the conclusion that such underestimation is minor relative the scale of the Upper Touchet forest vegetation analysis area. Furthermore, the underestimation was partially mitigated by assigning many early to mid-aged stands an understory component based on ecological knowledge of the local area and processes of competition, succession, and disturbance.

### *Validation of data and error estimation – suitability for project level analysis*

The data utilized for the project vegetation analysis are considered suitable because they have been validated in such a manner as to allow estimation of possible error, and that likely errors are within ranges considered acceptable by agency policy and/or standard professional practice in the field of forestry. Within the project analysis area, estimates of vegetation attributes are based on a combination of formal measurements (using standard methods such as Common Stand Exam and quantified imputation in the Most Similar Neighbor process), and more informal assessments (walk-through exams and/or aerial photo interpretation). The formal methods produce quantitative, statistical estimates of error, which were evaluated early in the project effects analysis. Informal methods produce more qualitative estimates of data error, which are evaluated using professional judgement and discretion reasonable acceptable and common in the practice of forestry. Data collected via both formal and informal methods were cross-checked to assess possible sources of bias or systematic sources of error.

The formal and informal approaches described in the preceding paragraph were both utilized in the assessment of data and data analysis for the Project. Formal measurements using common stand exam methods and most similar-neighbor imputation yielded statistical error estimates and a project-wide canonical r-squared value above that which is considered by commonly accepted agency standards to be suitable for project-level analysis (Justice 2016). These measurements were further strengthened extensive “walk-through” stand examinations on the ground and careful aerial photo interpretation by an experienced photogrammetrist. Because either of these methods alone is considered suitable for project-level data analysis in the field of forestry, and in combination both methods strengthened each other, they are considered suitable for use in the Project environmental analysis.

### *Interpretation of data and prediction of effects*

Forest vegetation data were interpreted and effects of tree-cutting activities predicted by evaluating every stand affected by an action alternative on an individual basis, combining the sources listed above as much as possible. For areas being treated with a landscape burn, effects on forest structure were predicted for each vegetation polygon based on the vegetation species present, fuel arrangement and loading, slope, and biophysical environment. Predictions made for all vegetation polygons were then placed in context with an assumption that approximately 60% of the total burn unit would actually be blackened.

The various sources of information and an estimated effect were considered using best professional judgement of a trained forester possessing silvicultural certification credentials conferred by the Forest Service. Assumptions and estimates were independently validated against published literature and Forest Vegetation Simulator model runs.

### *Use of methods standard in the practice of forestry*

The methods described in this section are considered standard in the practice of forestry, because they have been either adopted as required agency policy by the US Forest Service (widely considered the largest and most-respected forest management organization in the world), have been suggested in academic training provided at accredited American university forestry programs, or are described in canonical texts pertinent to the practice of forestry (Avery and Burkhardt 2002). The only other methods used to assess forest vegetation for project-level effects analysis include relatively unusual and often cost-prohibitive approaches such as LiDAR (a portmanteau of “Light” and “Radar”) and 100% tree-sampling. Although the use of LiDAR is growing rapidly as costs decrease over time, it is not yet considered standard in the practice of forestry.

### *Incomplete and Unavailable Information*

As with any assessment of forest vegetation and activity effects, this analysis is associated with incomplete and unavailable information, the most relevant and noteworthy of which is associated with either direct project effects, or indirect and cumulative effects. Incomplete and/or unavailable information associated with direct effects on forest vegetation include incomplete measurements (not every tree, shrub, forb, or graminoid is carefully measured), as well as uncertainty of project activity impacts: no one can know in the future exactly which trees will be harvested, what harvest impacts may occur (tree rubbing), or how broadcast burning activities will affect each and every plant. Future indirect and cumulative effects are also partially obscured by incomplete or unavailable information relating to uncertainty regarding impacts from future climate, insects, diseases, tree regeneration patterns, abiotic factors (extreme weather, comets, meteors, wildfires, earthquakes), and human activities not included within the cumulative effects analysis in this report.

## *Spatial and Temporal Context for Effects Analysis*

#### Spatial Context

The Upper Touchet forest vegetation analysis area is defined in this report as all Umatilla National Forest lands classified as dry, moist, or cold upland forest (Powell et al. 2007) within the geographic area shown in Figure 1. The forest analysis area analysis area is appropriate for the purposes of this silviculture report for three reasons: 1) all of the forest vegetation attributes affected by the Proposed Action are common and widely distributed throughout the planning area, the Ranger District in which it occurs, and the Umatilla National Forest containing the Ranger District; 2) Any specific Threatened, Endangered, or Sensitive tree, graminoid, shrub, or forb species occurring within and around the forest Analysis area and affected by the activities included under the action alternatives are addressed in this or other project resource reports; 3) Indirect and/or cumulative effects to forest vegetation resulting from the Activities proposed under the action alternatives and occurring outside the project forest analysis area as described in Figure 1 are highly speculative, negligible in scope and scale, and/or not measurable with a reasonable degree of accuracy.

#### Temporal Context

Direct effects of implementing activities under any action alternative of the Project were assumed to occur between the years 2020 and 2026—the anticipated timeframe for activity implementation. The effects analysis is bounded in time by considering the present period and how far into the past and future to consider human actions which have effects on vegetation resources that would overlap in time with the proposed Project. The temporal context for evaluating effects includes the temporal envelope of direct and indirect effects on forest vegetation resources of past, present, and reasonably foreseeable actions in the planning area, as described below. Indirect effects are estimated for 10-50 years into the future because that is a timeframe in which changes in structure, species composition, and density are expected to remain measurable and predictable with a reasonable degree of certainty. Beyond that timeframe, the moderate to high possibility of biophysical disturbances (insect outbreaks, wildfires, wind events, etc.) renders estimation of indirect effects highly speculative.

Past actions had an influence on past, existing, and in some cases future conditions. Existing conditions are described by a vegetation database developed for the planning area using field reconnaissance, aerial photo interpretation, and analysis of stand examination data. Database information was informally and qualitatively validated by completing field reviews during 2012-2016, which included walk-through examinations of approximately 30% of the stands within the Project Vegetation Analysis area (those stands accessible by ground transportation). In addition to non-anthropogenic disturbances, existing conditions reflect vegetation changes resulting from activities described in the cumulative effects section of this report. The temporal bounding of past effects is the era when vegetation management and fire suppression began in the project vicinity—approximately 1900.

Present (ongoing) actions and reasonably foreseeable future actions were considered for and integrated with the effects analysis. Reasonably foreseeable future activities are defined as those activities which are planned to occur after the year 2016 and for which a NEPA-compliant decision has been made, or is listed on the Umatilla National Forest Schedule of Proposed Actions (SOPA). Any activities that might occur at some future time beyond this planning timeframe, and/or are not on the SOPA, are highly speculative and not included in this analysis.

### *Past, Present, and Foreseeable Future Activities*

The Upper Touchet project Vegetation Analysis area includes a variety of past, present, and reasonably foreseeable future activities. These activities, and the relationship of their direct and indirect effects with the overlapping (in space and time) direct and indirect effects of the Upper Touchet project, are described in Table 4.

**Table 4. Activities with possible direct and/or indirect effects that overlap in space and time within the Upper Touchet (UPPER TOUCHET) Vegetation Analysis area**

| Activity | Specific Projects / Activities / Locations | Unit of Measure | Amount | Relationship to Upper Touchet Activity Effects on live Forest Vegetation | Additional information / notes / rationale |
|---|---|---|---|---|---|
| Slash and natural fuels reduction | All activity and natural fuels treatment activities within Upper Touchet forest vegetation analysis area occurring over the past 60 years and in the foreseeable future | Acres | See Table 5 | Negligible | The extent of past fuels activities overlapping with UPPER TOUCHET action alternative units is minimal. |
| Domestic livestock grazing | Unknown | AUMs | Extensive to minor, depending on time period | Compensating or Negligible | Past grazing activities can result in a number of effects on forest vegetation, including a reduction of fine fuel continuity and associated fire-caused mortality of seedlings and sapling-size trees. These effects, like the fire suppression effects above, generated a kind of ecological "inertia," which tends to inhibit or constrain restorative treatments. The extent to which this is associated with past grazing is unclear in the Upper Touchet area, but likely minor relative to fire suppression. Present and reasonably foreseeable future livestock grazing generally does not occur in, or affect the Upper Touchet forest vegetation analysis area. |
| Fire suppression activities and fire exclusion | 60 years of wildfire suppression by state and federal agencies / Present and planned fire suppression/exclusion in the Upper Touchet project area | Number of fires over past 60 years within 5-mile radius of project area | 145 | Compensating | Past activities such as fire suppression generate a kind of ecological "inertia," which tends to inhibit or constrain restorative treatments (Fig. 9 in Stine et al. 2014). In the absence of future wildfire disturbances, as successional and growth processes are allowed to continue, Upper Touchet project effects would diminish over time. |
| Herbicide application for invasive plant control | 2010 Invasive Plants Treatment Project Record of Decision | Acres | 200 | Negligible | Past, present, or reasonably foreseeable future invasive plant treatments target herbaceous species only and are not known to affect present tree distribution, density, survival or growth to an appreciable degree. |
| Issuance of Special Forest Products permits | Annual permits issued for outfitters and guides, commercial mushroom collection, personal-use firewood, and Christmas trees | Number of permits issued annually | <1000 | Negligible | Permit-holders typically have a minimal impacts on forest vegetation affected by expected Upper Touchet project activities. Christmas tree permits do not allow cutting in plantations. |
| Ski area development and management | Ski Bluewood | Acres | 500 | Amplifying | Skier activity would tend to perpetuate the open, single-stratum conditions created and maintained by the UPPER TOUCHET project, through physical damage to regenerating seedlings. |

| | | | | | |
|---|---|---|---|---|---|
| Precommercial thinning (PCT) | All PCT activities within Upper Touchet forest vegetation analysis area occurring since 1960 | Acres | Table 5 | Amplifying | Past PCT activities are expected to amplify or enhance Upper Touchet activity effects because trees remaining after PCT treatments are more apt to persist and thrive following Upper Touchet activities, as well. |
| Tree-planting | All tree-planting activities within the UPPER TOUCHET forest vegetation analysis area occurring since 1960 | Acres | Table 5 | Negligible | The extent of past tree-planting activities overlapping with UPPER TOUCHET action alternative units is minimal. |
| Timber harvest | All timber sales within Upper Touchet forest vegetation analysis area occurring over the past 60 years and in the reasonably foreseeable future. | Acres | Table 5 | Amplifying | Past timber harvests have tended to result in a higher proportion of desired species in Upper Touchet units planned for NCT activities. This results in a greater shift toward desired species resulting from Upper Touchet implementation than would have otherwise occurred. |
| Trail and road operations and maintenance (grading, ditch-cleaning, hazard-tree removal, culvert-cleaning) | Forest Visitor Use Map incorporated by reference | Miles | Less than 100 | Negligible | Activities included in both action alternatives to affect forest vegetation almost always occur outside the footprint of roads and trails. |

**Table 5. Past timber, fuels, and other silvicultural activity extent within the Upper Touchet vegetation analysis area between approximately 1950 and 2018.**

| Row Labels | Sum of Acres |
|---|---|
| **1950-1959** | **599.0** |
| Commercial Thin | 422.9 |
| Sanitation Cut | 134.2 |
| Stand Clearcut (EA/RH/FH) | 41.9 |
| **1970-1979** | **161.5** |
| Fill-in or Replant Trees | 0.1 |
| Plant Trees | 40.0 |
| Reforestation Need Created by Harvest | 40.3 |
| Shelterwood Establishment Cut (with or without leave trees) (EA/RH/NFH) | 1.0 |
| Site Preparation for Planting - Other | 40.0 |
| Stand Clearcut (EA/RH/FH) | 40.0 |
| **1980-1989** | **1519.8** |
| Certification-Planted | 39.9 |
| Commercial Thin | 552.3 |
| Fill-in or Replant Trees | 0.1 |
| Improvement Cut | 404.8 |
| Overstory Removal Cut (from advanced regeneration) (EA/RH/FH) | 106.8 |
| Patch Clearcut (EA/RH/FH) | 25.4 |
| Plant Trees | 1.2 |
| Pretreatment Exam for Release or Precommercial Thinning | 16.5 |
| Sanitation Cut | 18.3 |
| Shelterwood Establishment Cut (with or without leave trees) (EA/RH/NFH) | 338.2 |
| Shelterwood Removal Cut (EA/NRH/FH) | 0.2 |
| Single-tree Selection Cut (UA/RH/FH) | 6.2 |
| Stand Clearcut (EA/RH/FH) | 9.9 |
| **1990-1999** | **2289.1** |
| Certification-Planted | 83.9 |
| Invasive Species Inventories | 338.3 |
| Patch Clearcut (EA/RH/FH) | 2.4 |
| Plant Trees | 428.3 |
| Precommercial Thin | 16.5 |
| Pretreatment Exam for Release or Precommercial Thinning | 24.0 |
| Reforestation Need Change due to Stocking Changes | 82.9 |
| Reforestation Need Created by Harvest | 338.5 |
| Sanitation Cut | 19.9 |
| Site Preparation for Planting - Chemical | 338.2 |
| Site Preparation for Planting - Other | 210.2 |
| Stocking Survey | 338.8 |
| TSI Need Created- Precommercial Thin | 67.1 |
| **2000-2009** | **930.2** |
| Burning of Piled Material | 0.4 |
| Certification-Planted | 62.7 |
| Fuel Break | 84.5 |
| Fuel Inventory | 0.4 |
| Other Stand Tending | 96.4 |
| Piling of Fuels, Hand or Machine | 0.4 |
| Pretreatment Exam for Release or Precommercial Thinning | 66.8 |
| Reforestation Need Created by Fire | 0.4 |
| Salvage Cut (intermediate treatment, not regeneration) | 118.0 |
| Silvicultural Stand Examination | 39.9 |
| Special Products Removal | 6.0 |
| Stocking Survey | 255.6 |
| TSI Certification - Thinning | 16.5 |
| TSI Need (precommercial thinning) Eliminated | 67.8 |
| TSI Need Created- Precommercial Thin | 67.5 |
| Yarding - Removal of Fuels by Carrying or Dragging | 46.9 |
| **2010-2020** | **1000.0** |
| Burning of Piled Material | 58.5 |
| Certification-Planted | 0.4 |
| Chipping of Fuels | 93.8 |
| Fill-in or Replant Trees | 0.4 |

| | |
|---|---|
| Fuel Break | 0.3 |
| Invasives - Biocontrol, Classic | 289.5 |
| Invasives - Pesticide Application | 51.8 |
| Plant Trees | 0.4 |
| Plantation Survival Survey | 1.5 |
| Precommercial Thin | 39.8 |
| Pretreatment Exam for Release or Precommercial Thinning | 345.2 |
| Seeding grasses, forbs and/or shrubs | 116.6 |
| Stocking Survey | 1.7 |
| Watershed Resource Road Closure - Area | 0.0 |
| **Grand Total** | **6499.5** |

**Note**: This inventory reflects overlapping activities within a given location.

## Action Alternatives A, B, and D

This section summarizes the direct, indirect, and cumulative effects of implementing all action alternatives for the Upper Touchet project for the issues outlined above. The silvicultural activities for each action alternative vary primarily by geographic extent, which serves as a surrogate for the magnitude of direct and indirect environmental effects. A detailed description of project activities and design features is included in the project file, and is not duplicated in this report.

Direct and indirect effects are also described in several relevant technical reports, which are incorporated by reference to this report. They describe existing conditions in the Blue Mountains Ecoregion, and the biophysical processes of biotic disturbance, vegetation growth, and ecological succession in forests analogous to those in the project analysis area. The reports also describe the principles of disturbance severity and species/tree size selection and structural arrangement for various disturbance types. All species, structural stages, density classes, and potential vegetation communities described in the references below are considered directly analogous to the Upper Touchet project, and the direct, indirect, and cumulative effects of the action alternatives on wildfire, insect, and disease susceptibility, and forest vegetation structural stages. The geographic extent of the reports is larger than the extent of the Upper Touchet project analysis, but the same processes of cause-and-effect described in the reports apply.

- Filip et al. 1983
- Schmitt and Scott 1993
- Schmitt and Scott 2001
- Schmitt 1999
- Scott 1996a
- Scott 1996b
- Franklin et al. 2007
- Mallams et al. 2010
- Schmitt 1999

In this report, indirect, and cumulative effects are only described for Alternatives A and D, because Alternative B is less geographically expansive than the other two action alternatives but contains the same types of activities, and is thus diminished in magnitude, speed, extent, duration, and likelihood of effects. Direct effects are only described for Alternative D, because Alternatives A and B are less geographically expansive than Alternative D, and is thus diminished in magnitude, speed, extent, duration, and likelihood of effects. Differences between alternatives for activity type (single-tree selection versus commercial thin) would have little or no difference in direct effects, because stands would not contain established regeneration immediately following activity implementation.

### *Direct Effects*

Direct effects of implementing either project action alternative on forest vegetation are those which occur immediately following activity implementation, at the exact site of implementation. This report addresses possible effects on forest vegetation susceptibility to fire, insect and disease disturbances, and forest structural stages. Considerations of anticipated climatic changes are factored into activity effects analyses. Activity effects are assessed under the presumption that a circa-2050 climate under an Representative Concentration Pathway 6.0 will be 2-6 degrees F warmer than the 1950-1999 average. Precipitation during for the same time periods are projected to be 10% drier to 10% more moist (Taylor et al. 2012). Summer moisture may decline by up to 30% drier for summer months.

### Susceptibility to future insect and disease disturbance

Where direct effects of an action alternative are expected to occur, they almost always result in shifts of vertical structure, stand density and tree vigor toward conditions that are less susceptible to fir engraver beetle, many forms of stem rot, non-native adelgids, dwarf mistletoes, and defoliators (Schmitt and Powell 2005, Schmitt and Powell 2012, Schooley and Bryant 1978). Shifts in species composition in favor of early-seral species such as western larch, lodgepole pine, and ponderosa pine does not eliminate tree or stand susceptibility to biotic damage agents, as these tree species serve as hosts for their own variety of pests. At the same time, these species have relatively high levels of tolerance to heat and drought stress and thus higher physiological capacity to ward off insect and disease attacks. Furthermore, the activities considered under the project action alternatives would only increase the relative proportion and vigor of these species; not regenerate new cohorts or replace existing trees. The most important direct and indirect effect of the analyzed activities on insect and disease susceptibility has less to do with the host/attacker species assemblages and likely has more to do with reductions in stand density and shifts in composition toward species with more robust physiological defenses.

The project action alternatives are expected to reduce general susceptibility across the Upper Touchet forest vegetation analysis area in two additional ways. The first way is that the action alternatives would diversify species composition across the landscape by increasing species evenness, such that the abundance of less-represented tree species will increase, and vice-versa for more heavily represented species. Reducing the dominance of late-seral species across the project landscape is expected to have important direct effects on susceptibility to biotic disturbance development, allowing for reduced late-seral host availability and increased dispersion that constrains damage agents—insects (Hessburg et al. 1999, Lemkuhl et al. 1993, Lemkuhl et al. 1994). This method reduces susceptibility does so by reducing the overall amount of host species in a given stand and group of stands, as well as reducing the vulnerability of remaining host species because they are more isolated within a broader landscape and less prone to disturbance propagation and dispersion.

Landscape burning included under the action alternatives is expected to increase individual tree susceptibility to some bark beetles and wood borers in the short term, as damaged trees are often more susceptible to attack.  Following wildfires, land managers are naturally concerned about tree survivability. In some situations, there is a high likelihood of bark beetles infesting fire-weakened trees (Parker et al. 2006). Bark beetle outbreaks following wildfires are not unprecedented, but neither are they certain. Several conditions must exist for bark beetles to take advantage of fire-damaged hosts (Scott et al. 1996):

1. There must be a sufficient supply of undamaged inner bark in fire-affected trees. If beetles' food supply, the bark and inner bark (phloem), becomes dry or scorched—often the case in stand-replacing fires or in thin-barked tree species—beetles will neither feed nor lay eggs in it.

2. Fires must occur at a time when beetles either are, or soon will be, in the adult stage and capable of infesting susceptible trees. Fires in late summer or early fall may occur after beetles have flown or may be colonized by wood borers and may therefore not be as suitable to bark beetles the following year. A recently killed tree's inner bark remains usable to beetles for a relatively short time. If not attacked while still "green," phloem may become too dry or otherwise unusable before the next flight season.

3. There must be a population of beetles and borers within a reasonable distance to take advantage of weakened trees which become available.

4. Post-fire weather must be conducive to beetle survival and propagation.

Following three very large fires in the vicinity of the project area, post-fire insect attack was not substantial, likely for reason #2 discussed above, with low beetle populations and post-fire weather playing important roles as well. Prescribed fire would be applied in the fall, even later than recent wildfires, when the applicable insect species are not in the adult stages. Individual trees damaged but not killed by prescribed burning are expected to remain susceptible to attack for 2-3 years following the activity, but not at great enough numbers to encourage large growth in insect populations, even at a local level. Any increases in stand-level susceptibility as a result of prescribed fire application are expected to be minor and ephemeral.

#### Forest Structural Stages

The direct effects of implementing the activities included in Alternative D of the Upper Touchet Project on forest structural stage are described in Table 6. Effects within the analysis area are driven by variation of existing structural stages, fuel loading, species composition, and tree size, as well as silvicultural methods that reflect constraints and objectives associated with the Umatilla Forest Plan and Eastside Screens amendment. In general, where structural conversions are expected to occur as a result of tree-cutting activities, the old forest-multi strata class would convert to old forest-single stratum class and the understory re-initiation class would convert to a stem exclusion class. Some treatments—such as intermediate cutting methods in the old forest single-stratum, or thin-from-below cutting methods in young plantations in the stand initiation and stem exclusion stages—are not expected to alter structural classes in the near term.

Tree-cutting or prescribed burning activities in stands with understory reinitiation structures could either perpetuate such stages or convert them to stem exclusion or stand initiation stages depending on the species, size, and vigor of existing trees in the stand and the trees to be cut or burned. Not all silvicultural activities would be intended as thin-from-below intermediate treatments. Some, like single-tree selection cutting activities, could accelerate the transition of stands from a stem exclusion to an understory reinitiation phase or maintain a forest in the old forest multi-strata stage. Effects on structural stage depend partly upon silvicultural objectives for the stand (intended to alter composition, density, structure, or a combination of the three) and/or conditions of the stand itself. Prescribed fire treatments would be implemented using ignition techniques, timing, and control methods so as to achieve similar structural changes as those resulting from tree-cutting activities.

Prescribed burning activities in the large “landscape” unit are not expected to substantially alter the distribution of structural stages for several reasons. A large majority of burned areas would be of low or moderate intensity, by design (see Chapter 2 of the project Environmental Assessment). Low or moderate-intensity burning would generally not result in any more than 10-25% of dominant overstory mortality for a given stand, and such mortality would be limited to individual-tree or small-group torching. Conversions to stand initiation structural stages are expected only where stands are dominated by Engelmann spruce, a species highly intolerant of fire.

As discussed in the preceding paragraph, landscape fire would not substantially alter structural stage distribution because overstory mortality is expected to be limited, but there are other reasons that widespread changes in structural characteristics are not expected. OFMS and OFSS stands would largely retain existing structural characteristics because OFMS stands are dominated by a mix of species and tree sizes with variable tolerance of fire, so small amounts of tree mortality are expected in a variety of size classes. OFSS stands would likely retain their characteristics because large trees are not expected be killed in greater numbers than small trees, due to the composition of the size classes and/or bark thickness. Stands in the SE stage cannot, by definition, convert to the UR stage in as a direct effect of any activity, including prescribed burning, but in minor, isolated cases (see reference to individual-tree and small-group torching above), may convert to SI. In this project area, stands in the UR stage are expected to remain in this stage immediately following prescribed fire application due to the prevalence of fire-intolerant species and tree sizes, and resulting patterns of mortality.

Many of the existing old-forest stands (OFMS and OFSS) would be affected by proposed silvicultural activities under all the action alternatives, but the overall amount of old forest is not expected to decrease after implementation, because the proposed methods would retain the minimum number of sufficiently large trees per acre to maintain old-forest status as appropriate for a given forest type.

**Table 6. Direct effects of implementing the activities described under Alternative D on forest structural stages. BG stands for "bare ground"**

| | Existing Conditions | | Post-treatment Alt D | | Change from Existing Alt D | |
|---|---|---|---|---|---|---|
| | **Ac.** | **%** | **Ac.** | **%** | **Ac.** | **%** |
| **Dry Upland Forest** | | | | | | |
| SI & BG | 1642 | 37 | 15 | 30 | -1 | -0.0132 |
| SE | 288 | 6 | 10 | 20 | 0 | 0.0039 |
| UR | 564 | 13 | 0 | 5 | -1 | -0.0225 |
| OFSS | 471 | 11 | 40 | 65 | 0 | -0.0041 |
| OFMS | 1,471 | 33 | 1 | 15 | 0 | -0.0010 |
| Total | 10,977 | | | | | |
| **Moist Upland Forest** | | | | | | |
| SI & BG | 4486 | 17 | 20 | 30 | 9 | 0.0344 |
| SE | 2,517 | 10 | 20 | 30 | 72 | 0.2720 |
| UR | 3,352 | 13 | 15 | 25 | -74 | -0.2804 |
| OFSS | 4,688 | 18 | 10 | 20 | 476 | 1.8049 |
| OFMS | 11,304 | 43 | 15 | 20 | -483 | -1.8344 |
| Total | 9,963 | | | | | |
| **Cold Upland Forest** | | | | | | |
| SI & BG | 287 | 6 | 20 | 45 | 0 | 0.0000 |
| SE | 835 | 17 | 15 | 30 | 6 | 0.0222 |
| UR | 1,149 | 23 | 10 | 25 | -6 | -0.0222 |
| OFSS | 942 | 19 | 5 | 20 | 25 | 0.0952 |
| OFMS | 1,740 | 35 | 10 | 25 | -25 | -0.0952 |
| Total | 1,584 | | | | | |

## *Indirect Effects*

Over time, across the project treatment area and following implementation of action alternatives, processes of ecological succession would continue to favor the dominance of late-seral, shade-tolerant tree species over early-seral, shade-intolerant trees in the absence of fire events (Powell 2000, Agee

1993). Growing space would continue to be occupied and/or reoccupied by either a forested overstory, and/or understory forbs, shrubs and/or trees.

#### Susceptibility to future wildfire, insect and disease disturbances

Risks/susceptibility to wildfires, insect activity, disease, or other disturbances would gradually increase over time, but to a lesser degree and/or extent under the action alternatives than were no action to occur. Indirect effects on susceptibility to future insect and disease disturbances will diminish over time as forest density increases. The effects of wildfire suppression in the project Upper Touchet forest vegetation analysis area will enable forests to develop multi-strata canopies, shade-tolerant species to flourish, and stand density to increase, all of which are associated with increased susceptibility to a host of future biological disturbances. Until future disturbances occur, susceptibility to such disturbances will gradually increase to pre-implementation levels over a 50 to 75-year period.

#### Forest Structural Stages

The indirect effects of adopting any action alternative would be that areas converted by tree-cutting or burning activities to earlier structural stages would transition along growth/successional pathways at an earlier stage than if the activities had not occurred (Crane and Fisher 1986, O'Hara et al. 1996). Absent disturbances, the general sequence of structural development would generally proceed in the following order of stages: stand initiation, stem exclusion, understory reinitiation, old forest single stratum, old forest multi-strata. Future moderate or severe disturbances would convert areas to an earlier stage. Future low-severity disturbances will either perpetuate the old forest single-stratum stage, or advance succession by opening areas of growing space for development and/or recruitment of understory cohorts.

### *Cumulative Effects*

The CEQ regulatory definition of cumulative effects(40 CFR 1508.7) is stated as follows:

> "….. . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

The cumulative effects of the Project include the direct and indirect effects of the project activities themselves, in combination with the direct and indirect effects of all overlapping (in space and time) other past, present, and reasonably foreseeable future activities. The direct and indirect effects of the Project could either mitigate for/reduce, or amplify/enhance the effects of other activities. The relationships of Upper Touchet action alternatives and other activities with direct/indirect effects on forest vegetation that overlap in space and time are shown in Table 4. Regulatory thresholds for analyzed measures and indicators are defined and discussed in the consistency findings section below.

As discussed in the methodology section above, cumulative effects are assessed in this report through direct incorporation into the direct/indirect effects analysis, because cumulative effects of most activities are generally indistinguishable, unpredictable, and/or very difficult to measure relative to Upper Touchet activity effects. A typical example involves Upper Touchet action alternatives expected to have indirect effects on forest structural stages, as discussed in the direct and indirect effects sections above. Fire suppression and exclusion, as described in Table 4, is expected to generally have compensatory or countervailing indirect effects, but which are highly uncertain in timing, magnitude, extent, or other measures. As a result, the cumulative effects of Upper Touchet and suppression/exclusion activities are addressed together in the indirect effects section—particularly when discussing how Upper Touchet activities have indirect effects that diminish over the course of several decades as a partial result of fire suppression/exclusion.

### *Effectiveness of mitigation measures*

Mitigation measures are often identified and implemented to prevent and/or minimize undesired environmental effects. For forest vegetation, such effects include undesired damage to prescribed residual trees following tree-cutting and/or prescribed burning activities. Such damage may result in tree mortality or simply result in structural or physiological impairment of trees for the foreseeable future. Mitigation measures to avoid or minimize such impacts take the form of standard timber sale contract provisions to minimize damage to residual trees to the extent practicable and feasible during felling, skidding, piling, or pile-burning operations. For broadcast and landscape prescribed fire activities, mitigation measures focus on adjusting the timing, location, and pattern of ignitions to minimize undesired tree mortality, as well as pull-back of duff and other ground fuels from the base of large-diameter ponderosa pine. The protection of leave-trees implemented during felling operations is not included in the list of project design elements because it is a standard timber sale contract item.

These measures are expected to reduce undesired environmental effects, and the degree to which they would do so is reflected in the analysis of direct, indirect, and cumulative effects described above.

# Regulatory Framework: Project Consistency

This section includes assessment and findings of consistency with applicable laws, rules, and regulations pertaining to National Forest vegetation affected by the decision alternatives. Some laws not (e.g., the Clean Water Act) do not pertain to Forest Vegetation per se, and/or are discussed in other resource reports included in the project file, or other sections of this Environmental Impact Statement.

## National Forest Management Act of 1976 (NFMA)

Activities must of course be consistent with the letter and intent of the National Forest Management Act (NFMA; Public Law 94-588; 16 U.S.C. 1600); additionally, the Act requires specific findings to be made and documented when considering the implementation of certain management practices on National Forest System lands. A review of all activities proposed for the Upper Touchet project and their likely direct, indirect, and cumulative effects found that such activities are consistent with the NFMA. The basis and rationale for this consistency finding is described in this section.

### *Forest Plan and Amendments*

#### Forest Plan Standards and Guidelines

Forest-wide standards and guidelines (pages 4-47 to 4-93) guide implementation of management actions and pertain to all National Forest System lands located within the Umatilla National Forest, including the Upper Touchet project planning area. All Forest-wide standards and guidelines pertinent to live and dead forest vegetation will be incorporated into site-specific silvicultural prescriptions for all activities analyzed for this project.

## Consistency of Proposed Silvicultural Activities with Eastside Screens Forest Plan Amendment

### General Standards (items 1-3 in FP Amendment #11)

The Upper Touchet project action alternatives are consistent with the Screens general standards because they are designed to incorporate the interim ecosystem, and wildlife standards as discussed below, and incorporate the riparian standard by meeting PACFISH requirements, as documented in the fisheries and hydrology reports found in the project file. Items 2 and 3 are not pertinent because the Upper Touchet project is not claimed as an exception to Item 1.

### Ecosystem Standard (item 5 in Forest Plan Amendment #11)

The Upper Touchet project action alternatives are consistent with the Screens ecosystem standards for reasons described below, with reference to the applicable required component in the Eastside Screens.

**Item 5a:** Proposed timber-harvest activities were assessed relative to their associated watershed for patterns of stand structure by biophysical environment, and comparisons were made to the Historic Range of Variability (Martin 2010). The HRV used was developed for large landscapes across which geographic variation of forest types, environmental settings, and disturbance regimes is relatively uniform (Powell 2014b). The component watershed used for the Upper Touchet analysis has a range of conditions broadly reflective of the range of conditions for which the HRV was developed (interior Pacific Northwest montane forest ecosystems). Quantified vegetation analysis was limited to National Forest System lands within the Touchet River watershed and portions of adjacent watersheds.

**Item 5b:** To characterize forest ecosystems relevant to the Upper Touchet silviculture analysis, HRV was determined in Powell 2014b (and references therein) using the first 3 steps outlined in the Screens for Item 3b. Powell 2014b is incorporated by reference into this analysis. Step 4 of Item 3b was mapped for the project analysis, and structural stage abundance was calculated by biophysical setting (Table 3).

**Item 5c:** Differences between percent composition of structural stages between HRV and current conditions are also reported in Table 3. Structural conditions and biophysical environment combinations outside of HRV conditions were assessed to determine potential treatment areas.

### Wildlife Standard (item 6 in Forest Plan Amendment #11)

The Upper Touchet project action alternatives are consistent with the Screens wildlife standards for reasons described below, with reference to the applicable required component in the Eastside Screens. Key thresholds pertinent to cumulative effects are defined and indicated.

**Item 6a:** Multi-strata with Large Trees (OFMS) and Single Strata with Large Trees (OFSS) were assessed for all biophysical environments within the Upper Touchet forest vegetation analysis area.

**Item 6b:** LOS stages (OFMS and OFSS) were calculated separately for each biophysical environment, and Scenario B was chosen as the applicable scenario for the moist and cold upland forest biophysical environments, and Scenario A was selected as the applicable scenario for the dry upland forest biophysical environment.

**Item 6c:** The Upper Touchet analysis is not claiming an exemption from consideration of HRV, so this item does not apply.

**Item 6d (Scenario A; Dry upland forest only):** No tree-cutting activities will result in a net loss of LOS from any biophysical environment to which Scenario A applies. There are no timber harvest activities planned under any action alternative in areas with LOS stages below HRV.

1) Some tree-cutting activities are included under the action alternatives for areas in LOS stages within or above HRV and are designed as intermediate or individual-tree selection[2] cutting treatments. Such treatments are designed to maintain or enhance LOS within the pertinent biophysical environment by converting a stage above HRV (OFMS) to one currently within or below HRV (OFSS), and/or by altering density and/or species composition to improve residual tree vigor, size, and/or longevity.

2) Other tree-cutting activities included in the action alternatives are planned in areas outside of LOS with the intent to maintain and/or enhance LOS components as much as possible by adhering to all standards listed in the Screens amendment. These items are directly related to silvicultural design features related to the Eastside Screens Forest Plan amendment, described previously in this report.

    a) All remnant late and old seral and/or structural live trees ≥21" DBH that currently exist within stands proposed for harvest activities would be maintained

    b) Structure that does not meet LOS conditions would be manipulated in a manner that moves it towards these conditions as appropriate to meet HRV. Any areas treated in such a manner to move them away from LOS (e.g. seed-tree regeneration cutting activities) are included only because LOS conditions elsewhere are expected to meet HRV as a result of overall project effects.

    c) Where open, park-like conditions occurred historically (areas characterized by frequent, low-severity fire regimes), all treatments will maintain such conditions by implementing intermediate thin-from-below treatments and/or emphasize the removal of fire-intolerant species. A sufficient number of seedlings, saplings, and poles will be maintained to allow for the development of future stands.

3) Connectivity would be maintained and/or enhanced and fragmentation avoided because the project adheres to the following standards:

    a) Stands serving the purpose of connecting LOS stands and Forest Plan designated "old growth/MR" habitats would be maintained. These items are directly related to silvicultural design features related to the Eastside Screens Forest Plan amendment, described previously in this report.

        1) Activity units and prescriptions for both action alternatives were explicitly designed in such a manner that LOS stands and MR/Old Growth habitats would be connected to each other in a contiguous network by at least 2 different directions.

        2) Any activities that may occur in a connectivity corridor would be designed such that following implementation, medium and larger trees would remain common, canopy closures would remain within the top one-third of site potential, and stands would remain >400' wide at their narrowest point.

        3) Length of connection corridors is as short as possible

---

[2] Individual-tree selection cutting is classified as a regeneration method—not an intermediate treatment.

4) Harvests included under either action alternative and occurring within connectivity corridors would occur only if the above criteria are met, and if some amount of understory (if any occurs) is left in patches or scattered to assist in supporting stand density and cover.

b) Stands that do not currently meet LOS but are located within, or surrounded by, blocks of LOS stands are not considered for even-aged regeneration or group selection.

4) Wildlife-related items:

a) Design features pertaining to Snags, Green Tree Replacements, and Down Logs are included in the silvicultural design features section above. Snags and green replacement trees ≥21 inches dbh (or whatever smaller representative dbh of the overstory layer) would be retained at 100% potential population levels for primary cavity excavators. A consistency finding and rationale is also included in the project wildlife specialist report.

b) Every known active and historically used goshawk nest-site would be protected from disturbance. 30 acres of the most suitable nesting habitat surrounding all active and historical nest trees would be deferred from harvest. A consistency finding rationale for goshawks is also included in the project wildlife specialist report.

**Item 6e (Scenario B; Moist and col upland forest):** e. Scenario B

Within the moist and cold upland forests in the vegetation analysis area, both types of LOS stages occur and both are within or above HRV, and timber harvests would not cause LOS conditions to fall below HRV. The treatments LOS structural conditions and compositional or density attributes as possible.

1) Harvest activities, (any and all types being considered), would occur in the following stand types in order of priority:

a) Activities should occur within stands other than LOS as a first priority.

b) Second priority for harvest activities is within smaller, isolated LOS stands <100 acres in size, and/or at the edges (first 300 ft) of large blocks of LOS stands (≥ 100 acres).

c) Some harvesting would occur, as a last priority, within the interior of large LOS stands (≥ 100 acres); Even-aged regeneration and group-selection activities would not occur and remain consistent with non-fragmentation standards outlined in 3), below.

2) Maintain connectivity as directed in Scenario A, item 3)

3) Non-fragmentation standards – Within the interior of large LOS stands ≥ 100 acres, (beyond 300 ft from edge), harvest activities would be limited to non-fragmenting prescriptions such as thinning, single-tree selection (UEAM), salvage, understory removal, and other non-regeneration activities. Group selection cuts are not planned as part of the Upper Touchet project.

4) Adhere to wildlife prescriptions provided in SCENARIO A, 4) a) for snags, green tree replacements, and down logs; and 5) for goshawks with the following exception for goshawk post fledging areas in 5) c):

A 400-acre “Post Fledging Area” (PFA) would be established around every active nest site. While harvesting activities can occur within this area, up to 60% of the area would be retained in an LOS condition, (i.e., if 35% of the area is now in LOS stands then it all needs to be retained; if 75% of the area is now in LOS stands then some can be harvested, as long as this late and old stand structure does not drop below 60% of the area).

### *National Forest Land Suitability*

**Finding:** As described in the Management Direction section of this report, all silvicultural activities will be implemented only on lands meeting the definition of forest land (16 U.S.C. 1604) and designated as suitable for timber production by the Forest Plan (USDA Forest Service 1990), as amended.

### *Appropriateness of Even-aged Management*

**Finding:** All proposed even-aged management is considered an appropriate method to achieve the identified objectives and other Forest Plan components such as desired future conditions. No even-aged regeneration methods are prescribed under this project. Thus, the culmination of mean annual increment does not apply. No created openings would exceed 40 acres in size.

### *Optimality of Clearcutting*

No clearcutting methods are proposed as part of the Upper Touchet project.

### *Vegetation Manipulation*

**Finding:** Tree stand manipulation complies with requirements found in 16 U.S.C. 1604:

1. The proposed silvicultural activities are well suited to the multiple-use goals and objectives established for the Upper Touchet planning area when considering the potential environmental impacts associated with their implementation.
2. There is ample assurance that lands proposed for regeneration cutting (created openings in the context of the Forest Plan) will be adequately restocked within five years after final harvest, because the only regeneration cutting proposed under any alternative would retain a stand meeting minimum stocking requirements.
3. The proposed silvicultural prescriptions were not chosen primarily because they would give the greatest dollar return or the greatest output of timber, although these factors were considered when evaluating whether a proposed silvicultural activity was economically feasible.
4. The potential implementation effects on residual trees and adjacent stands were considered when developing the silvicultural proposals.
5. No permanent (e.g., irreversible) impairment of site productivity is expected as a result of the proposed silvicultural activities, and the project’s design features, management requirements, and best management practices ensure conservation of soil, slope, and other watershed conditions.
6. Silvicultural activities proposed for implementation in the Upper Touchet Vegetation and Fuels Management Project are expected to provide desired effects with respect to water quantity and quality, wildlife and fish habitat, regeneration of desirable tree species, forage production, recreation uses, aesthetic values, and other resource yields.
7. Silvicultural activities proposed for implementation in the Upper Touchet Vegetation and Fuels Management Project are considered practical in terms of transportation and harvesting requirements, and total financial costs of project preparation, timber harvest, and sale administration.

## References

Not all of the references included below were cited in this specialist report, but all references were consulted as part of the project effects analysis and provide a basis for analysis findings.


**Center for Climate Strategies. 2007.** Washington State Greenhouse Gas Inventory and Reference Case Projections, 1990-2020. Prepared for Washington State Department of Ecology. Accessed 18 Apr 2017. http://www.ecy.wa.gov/climatechange/docs/WA_GHGInventoryReferenceCaseProjections_1990-2020.pdf

**Cochran, P.H.; Geist, J.M.; Clemens, D.L.; Clausnitzer, R.R.; Powell, D.C. 1994.** Suggested stocking levels for forest stands in northeastern Oregon and southeastern Washington. Res. Note PNW-RN-513. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 21 p.

**Dixon, G.E., comp. 2002.** Essential FVS: A user's guide to the Forest Vegetation Simulator. Internal Rep. Fort Collins, CO: USDA Forest Service, Forest Management Service Center. 226 p. (Revised: January 8, 2014) http://www.fs.fed.us/fmsc/ftp/fvs/docs/gtr/EssentialFVS.pdf

**Goetz, S. J.; Bond-Lamberty, B.; Law, B. E.; Hicke, J. A.; Huang, C.; Houghton,R. A.; McNulty, S.; O'Halloran, T.; Harmon, M.; Meddens, A. J. H.; Pfeifer, E. M.; Mildrexler, D.; Kasischke, E. S.** 2012. Observations and assessment of forest carbon dynamics following disturbance in North America. Journal of Geophysical Research. 117(G02022): 1-17.

**Halofsky, J.E., and Peterson, D.L., eds. 2017**. Climate change vulnerability and adaptation in the Blue Mountains Region. Portland, OR: Gen. Tech. Rep. PNW-GTR-939. USDA Forest Service, Pacific Northwest Research Station. 331 p.

**Helms, J.A., ed. 1998.** The dictionary of forestry. Bethesda, MD: Society of American Foresters. 210 p. isbn:0-939970-73-2

**Hessburg, P.F.; Smith, B.G.; Kreiter, S.D.; Miller, C.A.; Salter, R.B.; McNicholl, C.H.; Hann, W.J. 1999.** Historical and current forest and range landscapes in the interior Columbia River basin and portions of the Klamath and Great basins; Part 1: linking vegetation patterns and landscape vulnerability to potential insect and pathogen disturbances. Gen. Tech. Rep. PNW-GTR-458. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 357 p. http://www.treesearch.fs.fed.us/pubs/29638

**Hicke, J. A., Allen, C. D., Desai, A. R., Dietze, M. C., Hall, R. J., Hogg, E. H. Kashian, D. M.; Moore, D.; Raffa, K.F.; Sturrock, R.N.; Vogelmann, J.** (2012). Effects of biotic disturbances on forest carbon cycling in the United States and Canada. *Global Change Biology*, *18*(1), 7-34. doi:10.1111/j.1365-2486.2011.02543.x

**Kolb, T.E.; Fettig, C.J.; Ayres, M.P.; Bentz, B.J.; Hicke, J.A.; Mathiasen, R.; Stewart, J.E.; Weed, A.S. 2016.** Observed and anticipated impacts of drought on forest insects and diseases in the United States. Forest Ecology and Management. 380: 321-334.

**Law, B.E.; Turner, D.; Campbell, J.; Sun, O.J.; Tuyl, S. Van; Ritts, W.D.; Cohen, W.B.** 2004. Disturbance and climate effects on carbon stocks and fluxes across western Oregon USA. Global Change Biology. 10: 1429-1444

**Martin, K. 2010 (October 5).** Range of variation for forest vegetation project planning. Memorandum to S.O. Staff and District Rangers. Pendleton, OR: USDA Forest Service, Umatilla National Forest, Supervisor's Office. 6 p.

**McWilliams, M.G. 2017**. Ski Bluewood Hazard Tree Inspection. Memorandum to S.O. Staff and District Rangers. La Grande, OR: Blue Mountains Forest Insect and Disease Service Center. 2 p.

**National Research Council: Committee on Air Quality Management in the United States, Board on Environmental Studies and Toxicology, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2004)**. Air Quality Management in the United States. National Academies Press. ISBN 0-309-08932-8

**O'Hara, K.L.; Latham, P.A.; Hessburg, P.; Smith, B.G. 1996.** A structural classification for inland Northwest forest vegetation. Western Journal of Applied Forestry. 11 (3): 97-102.

**Powell, D.C. 1999.** Suggested stocking levels for forest stands in northeastern Oregon and southeastern Washington: an implementation guide for the Umatilla National Forest. Tech. Pub. F14-SO-TP-03-99. Pendleton, OR: USDA Forest Service, Pacific Northwest Region, Umatilla National Forest. 300 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5405482.pdf

**Powell, D.C. 2000.** Potential vegetation, disturbance, plant succession, and other aspects of forest ecology. Tech. Pub. F14-SO-TP-09-00. Pendleton, OR: USDA Forest Service, Pacific Northwest Region, Umatilla National Forest. 88 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5358579.pdf

**Powell, D.C.; Johnson, C.G., Jr.; Crowe, E.A.; Wells, A.; Swanson, D.K. 2007.** Potential vegetation hierarchy for the Blue Mountains section of northeastern Oregon, southeastern Washington, and west-central Idaho. Gen. Tech. Rep. PNW-GTR-709. Portland, OR: USDA Forest Service, Pacific **Northwest Research Station. 87 p. http://www.treesearch.fs.fed.us/pubs/27598**

**Powell, D.C. 2013.** Active Management of Moist Forests in the Blue Mountain: Silvicultural Considerations. White Pap. F14-SO-WP-Silv-7. Pendleton, OR: USDA Forest Service, Pacific Northwest Region, Umatilla National Forest. 328 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5405491.pdf

**Powell, D.C. 2014b.** Range of variation recommendations for dry, moist, and cold forests. White Pap. F14-SO-WP-Silv-3. Pendleton, Oregon: USDA Forest Service, Pacific Northwest Region, Umatilla National Forest. 58 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5326219.pdf

**Quigley, T.M.; Arbelbide, S.J., tech. eds. 1997.** An assessment of ecosystem components in the Interior Columbia Basin and portions of the Klamath and Great Basins: volume 2. Gen. Tech. Rep. PNW-GTR-405. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 4 volumes: 337-1055. http://www.treesearch.fs.fed.us/pubs/24921

**Reineke, L.H. 1933.** Perfecting a stand-density index for even-aged forests. Journal of Agricultural Research. 46(7): 627-638.

**Schmitt, C.L. 1999.** Effects of stocking level control on the occurrence and severity of conifer diseases in the Blue Mountains of Northeast Oregon and Southeast Washington. Rpt. No. MBZ-99-04.

USDA Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest, Blue Mountains Pest Management Zone. 13 p.

**Schmitt, C.L. 2001.** Root diseases in conifer forested communities in the Blue Mountains of Northeastern Oregon and Southeastern Washington—detection and management, values and impacts. Rpt. No. MBPMSC-02-01. USDA Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest, Blue Mountains Pest Management Zone. 44 p.

**Schmitt, C.L.; Powell, D.C. 2005.** Rating forest stands for insect and disease susceptibility: a simplified approach. Version 2.0. Publication BMPMSC-05-01. La Grande, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest, Blue Mountains Pest Management Service Center. 20 p.

**Schmitt, C.L.; Powell, D.C. 2012.** Range of variation recommendations for insect and disease susceptibility. White Pap. F14-SO-WP-Silv-22. Pendleton, OR: USDA Forest Service, Umatilla National Forest. 16 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5358588.pdf

**Schooley, H. O., and D. G. Bryant. 1978**. *The balsam woolly aphid in Newfoundland*. Can. For. Serv. Nfld For. Res. Ctr. Inf. Rep. N-X-160. 72 p.

**Spiegel, L. 2017**. Bluewood Ski Area. Memorandum to S.O. Staff and District Rangers. La Grande, OR: Blue Mountains Forest Insect and Disease Service Center. 2 p.

**Stine, Peter; Hessburg, Paul; Spies, Thomas; Kramer, Marc; Fettig, Christopher J.; Hansen, Andrew; Lehmkuhl, John; O'Hara, Kevin; Polivka, Karl; Singleton, Peter; Charnley, Susan; Merschel, Andrew; White, Rachel. 2014**. The ecology and management of moist mixed-conifer forests in eastern Oregon and Washington: a synthesis of the relevant biophysical science and implications for future land management. Gen. Tech. Rep. PNW-GTR-897. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 254 p.

**USDA Forest Service. 1990.** Land and resource management plan: Umatilla National Forest. Portland, OR: USDA Forest Service, Pacific Northwest Region. Irregular pagination. http://www.fs.usda.gov/main/umatilla/landmanagement/planning#forest plan

**USDA Forest Service. 1994.** Decision notice for the continuation of interim management direction establishing riparian, ecosystem and wildlife standards for timber sales; Regional Forester's Forest Plan Amendment #1. Portland, OR: USDA Forest Service, Pacific Northwest Region. 11 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5211880.pdf

**USDA Forest Service. 1995.** Appendix B; Revised interim direction establishing riparian, ecosystem and wildlife standards for timber sales; Regional Forester's Forest Plan Amendment #2. Portland, OR: USDA Forest Service, Pacific Northwest Region. 14 p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5211858.pdf

**USDA Forest Service; USDI Bureau of Land Management. 1995.** Decision notice/decision record, finding of no significant impact, and environmental assessment for the interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California. Washington, DC: USDA Forest Service; USDI Bureau of Land Management. 72 p [plus glossary and many appendices]. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5211885.pdf

# Glossary and Acronyms

**Active management.** Human intervention into the nature, extent, and timing of disturbance to wildland ecosystems for the purpose of obtaining desired goods and services (Haeussler and Kneeshaw 2003). It has also been defined as the use of planning, thinning, prescribed fire, timber harvest, and reforestation to intentionally influence the health and resilience of a forest. In a climate-change context, active management refers to responses supporting ecosystem changes related to climate change (such as assisted species migration). For the Upper Touchet project, active management involves application of silvicultural activities to modify existing vegetation conditions and move them toward desired vegetation conditions.

**Activity fuel.** Combustible material resulting from, or altered by, forestry practices such as timber harvest or thinning, as opposed to naturally created fuels. Compare with: *natural fuel*. Also see: *fuel*.

**Adaptation.** A far-term climate change strategy adopting tactics such as minimizing negative ecosystem effects (reforest now with tree species expected to be tolerant of future droughts), or by exploiting potential opportunities to adapt to future climatic conditions. Adaptation is sometimes considered to be analogous with resilience. Adaptation and mitigation are important strategies, in some combination, to address climate change. For the Upper Touchet project, both near-term mitigation and far-term adaptation actions are planned, as described in the climate change section of this report.

**Adaptive management.** A dynamic approach to land management in which the effects of treatments and decisions are continually monitored and used, along with research results, to modify management on a continuing basis to ensure that objectives are being met (Helms 1998).

**Analysis area.** In a NEPA context, this is a description of the environment of area to be affected by the alternatives under consideration (40 CFR 1502.15).

**Artificial regeneration (tree-planting).** (see: Reforestation). The establishment of a stand of conifer species endemic to the Blue Mountains by hand-planting 1 or 2-year-old seedlings germinated and grown in a nursery. Tree seedlings are planted at higher densities than might normally occur, and in a relatively homogenous pattern, to ensure a forest is established soon after high-severity disturbance (wildfire, timber harvest, or wind events) at sufficient density to meet minimum stocking requirements described in the Forest Plan. Tree genotypes are selected from seed orchards or individuals with apparently superior form and growth in wild collection areas.

**Bark beetles.** Small, often cylindrical beetles in the family Scolytidae that bore through the bark of host trees to lay their eggs and, as larvae, they tunnel and feed in the inner bark (Doliner and Borden 1984). For the Upper Touchet project, bark beetles of particular concern include: Douglas-fir beetle, which affects older and larger Douglas-fir; mountain pine beetle, which affects second-growth ponderosa pine forest; fir engraver, which affects older and larger grand fir; and western pine beetle, an important killer of older and larger ponderosa pine.

**Basal area.** The surface area of a woody stem (or stems), including bark, as if cut off at a certain height (such as breast height or 4½ feet above the ground); also, the surface area of all stems in a stand and expressed per unit of land area (basal area per acre). Basal area is a way to measure how much of a site is occupied by trees. For the Upper Touchet project, stand density index (SDI) is a stocking metric used to formulate suggested stocking levels, although SDI values are translated into their corresponding basal area values when preparing marking guides for operational timber designation activities.

**Biophysical environment.** Landscape-level unit of vegetation composition and structure, with its associated environmental gradients and processes of change (Powell et al. 2007). Note that ‘biophysical’ refers to a combination of biological and physical components of an ecosystem. For the Upper Touchet project, potential vegetation groups (PVGs) are used as biophysical environments.

**Breast height.** A standard height from ground level, generally 4.5 feet (1.37 m), for recording diameter, circumference (girth), age, or basal area of a tree (adapted from Helms 1998). Measurement at breast height is usually taken on the uphill side of the tree and includes any duff layer that may be present, but does not include unincorporated woody debris lying upon the ground surface (Helms 1998). For the Upper Touchet project, tree diameter is measured at breast height (e.g., diameter at breast height, or dbh).

**Breast-height age.** The number of rings from the center (pith) of a tree to the cambium layers, and counted at breast height (Helms 1998). For the Upper Touchet project, tree age is determined by using an increment borer to extract an increment core from a tree at breast height (same point on stem where diameter is measured), and then counting the annual rings from the pith to the cambium. For the Upper Touchet project, tree age is measured at breast height (e.g., age at breast height, or abh).

**Burn severity.** Fire severity and burn severity are sometimes used interchangeably. Note that burn severity relates specifically to soils, particularly to the loss of organic matter from, and directly above, the mineral soil (Keeley et al. 2009). Compare with: *fire severity*.

**Canopy Cover. The ground area covered by the crowns of trees or woody vegetation as delimited by the vertical projection of crown perimeters and commonly expressed as a percent of total ground area (syn. Crown Cover).**

**Climax.** The culminating seral stage in plant succession for any given site where, in the absence of catastrophic disturbance, the vegetation has reached a highly stable condition and undergoes change very slowly (Dunster and Dunster 1996). The stage of plant development in which vegetation is thought to be stable, self-sustaining, and self-replicating. Also refer to: *seral stage: potential natural community*.

**Cohort.** A group of trees developing after a single disturbance, commonly consisting of trees of similar age, although one cohort can include a considerable span of ages ranging from seedlings or sprouts to trees that predated the disturbance (Helms 1998). Stands are often characterized as single-cohort or multicohort depending on whether they contain one or several cohorts (Oliver and Larson 1996). The Upper Touchet planning area contains two multi-cohort structural stages – understory reinitiation and old forest multi-strata, and three single-cohort structural stages – stand initiation, stem exclusion, and old forest single stratum. Also see: *structural stage*.

**Commercial thinning.** Any type of tree thinning producing merchantable material at least equal in value to the direct costs of timber harvest.

**Community.** In an ecological context, a community is made up of all of the interacting populations in an environment. Community refers to a group of organisms that tends to occur together under similar environmental conditions, occupying the same habitat or area and interacting with each other (Doliner and Borden 1984). Community is usually considered to be a smaller spatial scale than an ecosystem.

**Competition.** Negative interactions between individuals of either the same or different species that utilize common and limited resources such as nesting sites, nutrients, or prey (Doliner and Borden 1984). For trees, competition results in a density-related scarcity of certain environmental factors, primarily relating to soil moisture and nutrients, that are important for tree growth and survival (Helms 1998).

**Connectivity.** Ecological conditions existing at several spatial and temporal scales and providing landscape linkages to permit the exchange of water flow, sediments, and nutrients; daily and seasonal movements of animals within home ranges; dispersal and genetic interchange between populations; and long distance range shifts of species, such as in response to climate change (USDA Forest Service 2012). For the Upper Touchet project, the width and location of connectivity corridors are influenced by requirements from the Eastside Screens amendment to the Forest Plan.

**Cover type.** The plant species forming a plurality of the composition across a given land area, e.g., the Engelmann spruce-subalpine fir, ponderosa pine-Douglas-fir, or lodgepole pine forest cover types

(Helms 1998). Forest cover types of the United States and Canada are described in Eyre (1980). For the Upper Touchet project, cover type assignments are based on vegetation characteristics derived from the Most Similar Neighbor imputation process (see Methodology section of this report), field reconnaissance, and aerial photo interpretation.

**Crown (tree).** The part of a tree or woody plant bearing live branches and foliage.

**Crown class.** A categorization or classification of trees based on their crown position relative to adjacent trees within the same canopy stratum; four primary crown classes are recognized:

**Dominant.** A tree whose crown extends above the general level of the main canopy, receiving full light from above and partial light from the sides.

**Codominant**. A tree whose crown helps to form the general level of the main canopy, receiving full light from above and limited light from the sides.

**Intermediate**. A tree whose crown extends into the lower portion of the main canopy but is shorter than the codominants, receiving little direct light from above and virtually none from the sides.

**Subcanopy (overtopped).** A tree whose crown is completely overtopped by the crowns of one or more neighboring trees, occurring in a subordinate or submerged position relative to the main canopy.

**Crown fire.** An intense fire that burns through the upper tree or shrub canopy, spreading from one woody crown to another above the ground. In most cases the understory vegetation is also burned. Depending on species, a crown fire may or may not be lethal to all dominant vegetation. An example of this would be many shrub and broadleaf tree species that sprout from roots, root crowns, or stem bases after their tops are killed. A crown fire may be continuous, or it may occur as patches within a lower severity burn (Sommers et al. 2011). Three types of crown fire are commonly recognized:

**Passive crown fire.** This crown fire type is characterized by the torching of a small group of trees (Stephens et al. 2012); a solid or continuous flaming front, in canopy fuels, cannot be maintained except for short periods.

**Active crown fire.** This crown fire type is characterized by fire spreading continuously in canopy fuels. Two types of active crown fire are recognized:

**Independent crown fire.** This crown fire type spreads without the aid of a supporting surface fire (Sommers et al. 2011). For example, a strongly wind-driven, independent crown fire is sometimes observed in boreal forest during late winter or spring when snow still covers surface fuels.

**Dependent crown fire.** This crown fire type spreads in canopy and surface fuels simultaneously (Stephens et al. 2012). For the Upper Touchet project, many of the silvicultural activities proposed for implementation, including prescribed fire, are designed to minimize future risk of dependent crown fire.

**Danger tree.** A tree, or its parts, that is likely to fail within one and ½ tree lengths of an open class 3 or higher system road, any road designated for timber hauling, or a developed recreation or administrative site (Toupin et al. 2008). Also known as: *hazard tree*. The Upper Touchet project includes design features and other measures to address danger trees along travel routes.

**Desired future conditions (desired conditions).** A description of the land or resource conditions that are believed necessary if goals and objectives are to be fully achieved (Helms 1998). For the Upper Touchet project, forest vegetation desired conditions are based primarily on ranges of variation for species composition, forest structure, and stand density, as well as Fire Regime Condition Class and forest product availability.

**Disease.** Any more or less prolonged disturbance of an organism that interferes with its normal structure or function; the causes of disease are both biotic and abiotic (Doliner and Borden 1984). For the Upper Touchet project, the primary diseases of concern involve parasitic dwarf mistletoes affecting

Douglas-fir, ponderosa pine, and western larch; Armillaria and annosus root diseases; and rust-red stringy rot stem decay in grand fir caused by Indian paint fungus (Schmitt and Spiegel 2010, 2012).

**Disturbance.** A relatively discrete event that disrupts the structure of an ecosystem, community, or population, and changes resource availability or the physical environment. Disturbances include processes such as fires, floods, insect outbreaks, disease epidemics, and windstorms (Dodson et al. 1998). For the Upper Touchet planning area, the primary disturbance processes of historical importance include wildfire, and defoliation of mixed-conifer forests by western spruce budworm and Douglas-fir tussock moth, and periodic outbreaks of various bark beetle species.

**Disturbance regime.** A description of the characteristic types of disturbance on a given landscape; the frequency, severity, and size distribution of these characteristic disturbance types; and their interactions (USDA Forest Service 2012). Description of a disturbance regime would include characteristics such as the spatial distribution of disturbance events; disturbance frequency (number of disturbance events in a specified time interval, or the probability of a disturbance event occurring within a particular time interval); return interval (average time between successive disturbance events); rotation period (length of time until an area equivalent to the size of an analysis area would be affected in one disturbance event); disturbance size; and the magnitude, or intensity, of a disturbance event (Dodson et al. 1998).

**Dripline.** The width of a tree crown, measured as the outermost point at which a drop of water would fall vertically from the crown foliage and reach the ground rather than other foliage. It is expressed as either a radial distance from the tree trunk (bole, stem) to the dripline, or as a diameter of the area encompassed from one edge of the dripline to the other (Dunster and Dunster 1996). For the Upper Touchet project, dripline is defined as a radial distance measured from the tree stem to the outermost extent of the tree's crown.

**Dry upland forest**. A potential vegetation group associated with biophysical environments where the climate, soil depth, and other physical site factors allow development of a tree-dominated ecosystem supporting vegetation types characteristic of relatively warm or hot temperature conditions, and dry or xeric moisture regimes (Powell et al. 2007).

**Eastside Screens.** A Regional Forester's Plan Amendment establishing riparian, ecosystem, and wildlife standards specifically for timber sales. The screening process was intended as a short-term measure to shift harvest emphasis away from large trees to small and medium-sized trees that had filled in the forests during the era of fire exclusion. The process asks IDTs to assess the pattern, abundance, and variability of all successional conditions by vegetation type for the watersheds in question. Through this process, it would be determined whether a biophysical environment may consider the removal of trees larger than 21" DBH if the existing late and old structural stages occur within or above HRV, and enhancing LOS attributes wherever possible.

**Ecological integrity.** The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation, and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (USDA Forest Service 2012).

**Ecosystem.** A spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its: (1) Composition. The biological elements within the different levels of biological organization, from genes and species to communities and ecosystems. (2) Structure. The organization and physical arrangement of biological elements such as, snags and down woody debris, vertical and horizontal distribution of vegetation, stream habitat complexity, landscape pattern, and connectivity. (3) Function. Ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances such as wind, fire, and floods. (4) Connectivity. (USDA Forest Service 2012). Also see: *connectivity*.

**Ecosystem services.** Ecosystem services include provisioning services such as food, water, timber, and fiber; regulating services affecting climate, floods, disease, wastes, and water quality; cultural services providing recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling (Hassan et al. 2005). For the Upper Touchet project, implementation of silvicultural activities is projected to enhance all four categories of ecosystem services.

**Even-aged stand.** A stand of trees composed of a single age class (USDA Forest Service 2012).

**Existing vegetation.** Vegetation found at a given location at the time of observation (Jennings et al. 2003). Compare with: *potential vegetation*. For the Upper Touchet project, existing vegetation characterizations are based on vegetation attributes derived from the Most Similar Neighbor imputation process (see Methodology section of this report).

**Fire.** A self-sustaining chemical reaction releasing energy in the form of light and heat (Brenner 1998). Four types of fire are commonly recognized (arranged from least intense to most intense):

**Ground fire.** Fires burning in surface organic materials such as peat or deep duff layers. Ground fires typically undergo a large amount of smoldering combustion and less active flaming than other fire types. They may kill roots of overstory species due to prolonged high temperatures in the rooting zone (Sommers et al. 2011). [Although the terms are often used interchangeably, and incorrectly so, *ground fire is not the same as surface fire*.]

**Surface fire.** Fires burning only the lowest vegetation layer, which may consist of grasses, herbs, low shrubs, mosses or lichens (live fuels), and dead tree foliage and branchwood cast into the surface fuelbed from the overstory canopy. In forests, woodlands, or savannas, surface fires are generally low to moderate severity, and do not cause extensive overstory mortality (Sommers et al. 2011). For the Upper Touchet project, surface fire was by far and away the most common fire type historically because it affected both dry upland forest sites and nonforest environments.

**Mixed-severity fire.** For this fire regime, fire severity varies between nonlethal understory fire and lethal stand replacement fire, with the variation occurring in space (between polygons) or time (within the same polygon). In some vegetation types, the stage of succession, the understory vegetation structure, the fuel condition, or the weather may determine whether a low or high-severity (or surface or crown) fire occurs. In this scenario, individual fires vary over time between low-severity surface fires and longer-interval stand replacement fires. In other situations, the severity may vary spatially as a function of landscape complexity or vegetation pattern, in which case the result may be a mosaic of young, old, and multi-aged vegetation patches (Sommers et al. 2011).

**Stand replacement fire.** A fire that is lethal to most of the dominant, above-ground vegetation, with the result that it substantially changes the vegetation structure. Stand replacement fires may occur in forests, woodlands and savannas, annual grasslands, and shrublands. Depending on the vegetation type being affected, stand replacement fire may result from crown fire, high-severity surface fire, or ground fire (Sommers et al. 2011). Also see: *crown fire*.

**Fire behavior.** This term relates to the manner in which fire reacts to fuel, weather, and topography; common terms used to describe fire behavior include smoldering, creeping, running, spotting, and torching (Sommers et al. 2011).

**Fire exclusion.** Areas where wildland fires were eliminated, including areas historically exposed to traditional Native American burning (Rapp 2002). For the Upper Touchet project, fire exclusion is believed to have exerted the most influence on existing forest conditions, although historical levels of selective timber cutting and ungulate grazing also played important roles (Powell 2014a).

**Fire frequency.** The number of times that fire occurs within a defined geographical area and during a specific time period. Fire frequency is sometimes characterized by using fire return intervals: very frequent (0-25 years between fires); frequent (26-75 years); and infrequent (76-150 or more years) (Sommers et al. 2011).

**Fire intensity.** Fire intensity describes the physical combustion process of energy release from organic matter. It is often expressed as fireline intensity – the rate of heat transfer per unit length of fireline. Since there is often a consistent relationship between fireline intensity and flame length, flame length may be used as a measure of fireline intensity (Keeley et al. 2009). Three intensity classes are recognized: low (average flame length of less than 3 feet), intermediate (average flame lengths of 3 to 9 feet), and high (flame lengths exceed 9 feet).

**Fire regime.** A fire regime is a generalized description of the role fire plays in an ecosystem (Agee 1993). When characterizing a fire regime, the following attributes are often included: frequency, magnitude (intensity and/or severity), variability, seasonality, synergism, and extent (Agee 1998). Note that many fire regime classification systems exist; a recent one recognizes three primary regimes for <u>forested</u> environments (Brown and Smith 2000): (1) understory – fires are generally nonlethal to dominant vegetation (80% or more survives), and they do not change its structure; (2) mixed severity – fire either causes selective mortality in dominant vegetation (depending on its fire tolerance), or it varies between the understory and stand-replacement modes; and (3) stand replacement – fire kills or consumes the dominant vegetation (80% or more is either killed or consumed), and the forest structure is changed substantially. Compare with: *disturbance regime*.

**Fire return interval.** This metric describes the time between fires in a defined area, usually at the scale of a point, stand, or relatively small landscape area. This is called Mean Fire Interval (MFI) in the LANDFIRE system, when it refers to the average number of years between fires in representative stands (Barrett et al. 2010).

**Fire severity.** Fire severity relates to the loss (death) or decomposition of organic matter both aboveground and belowground, including tree mortality as a 'loss' component, but this mortality context is most appropriate for trees lacking any sprouting capacity. Fire severity is correlated with fire intensity (Keeley et al. 2009). Compare with: *fire intensity*. For forest vegetation analyses for the Upper Touchet project, fire effects are typically characterized as fire severity, because they relate directly to tree mortality, rather than fire intensity.

**Fire suppression.** All activities associated with controlling and extinguishing a fire following its detection (Dunster and Dunster 1996). Compare with: *fire exclusion*.

**Forest**. An ecosystem characterized by more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, streams, fish, and wildlife (Helms 1998).

**Forest density management.** Cutting or killing trees to increase inter-tree spacing and accelerate growth of remaining trees; the manipulation and control of forest (tree) density to achieve one or more resource objectives. Forest density management is often used to improve forest health, to open the canopy for selected trees, to maintain understory vegetation, or to promote late-successional characteristics for biological diversity (Helms 1998). For the Upper Touchet project, forest density management activities include commercial, noncommercial, and juniper/shrub-steppe thinnings.

**Forest floor.** A general term encompassing the layer of undecomposed organic matter (leaves, twigs, and plant remains in various stages of decomposition) lying on top of the mineral soil (Dunster and Dunster 1996).

**Forest health.** The perceived condition of a forest based on concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance. Note that perception and interpretation of forest health is influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of stands comprising the forest, and the appearance of a forest at any particular point in time (Helms 1998).

**Forest management.** Intentional manipulation of forest ecosystems to influence their composition, structure, or density, and the nature of the products and services they provide (Burger 2009). Also see: *active management*. For the Upper Touchet project, forest management involves application of silvicultural activities to modify existing vegetation conditions and move them toward desired vegetation conditions.

**Forest stand.** A contiguous group of trees sufficiently uniform in age-class distribution, composition and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit (Helms 1998). For the Upper Touchet project, forest stands (e.g., vegetation polygons) were used as the base-level planning unit, although similar stands are aggregated into treatment units when silvicultural activities are implemented on the ground.

**Fuel.** All of the dead and living material in an ecosystem that will burn; fuel includes grasses, dead branches and pine needles on the ground, as well as standing live and dead trees (Brenner 1998). Four types of fuel are commonly recognized (arranged from lowest to highest):

**Ground fuel.** A fuel component consisting of duff (the Oi soil horizon) and other materials (such as peat) lying on top of a mineral soil surface; ground fuels generally do not contribute to wildfire spread or intensity (Stephens et al. 2012).

**Surface fuel.** A fuel component including dead and down woody materials, litter, grasses, other herbaceous plant material, and short shrubs; surface fuels may be the most hazardous fuel component for some forest types (Stephens et al. 2012).

**Ladder fuel.** A fuel component consisting of small trees or tall shrubs providing vertical continuity from surface fuels to canopy (crown) fuels (Stephens et al. 2012). Ladder fuels are important for initiating crown fire, but they have little influence on crown fire spread.

**Crown fuel.** A fuel component comprised of overstory tree crowns and canopies (including foliage and small branches); note that the canopy and crowns of small trees (seedlings and saplings) are often included in the ladder-fuels category.

**Fuel load.** The amount of combustible material (living and dead organic matter) that is found in an area (Brenner 1998).

**Fuel management or treatment.** Any manipulation or removal of fuels to reduce the likelihood of fire ignition, lessen potential fire-caused damage, and improve resistance to control. For the Upper Touchet project, fuel management activities (treatments) will be directed by silvicultural prescriptions, marking guides, and burn plans.

**Gap.** In forestry usage, a gap is a space left in the canopy when one or more trees die, or after they are removed during timber harvest. For the Upper Touchet Project, gaps are used in association with variable-density thinning to create habitat for regeneration of shade-intolerant species including shrubs and herbs (Franklin et al. 2013). Compare with: *skip*.

**Grapple piling.** This fuels treatment activity utilizes mechanical equipment to pile woody material from two to nine inches in diameter and more than six feet in length. Grapple-piling treatments are designed so that residual fuel loading (after piles are burned or otherwise treated) will meet objectives established for the Upper Touchet project.

**Growing space.** An intangible measure of the total resources of a site (sunlight, moisture, nutrients, etc.) available to a plant (Helms 1998). Growing space refers to the availability of all resources needed by a plant to exist on a given site (O’Hara 1996).

**Harvest.** See: *timber harvest*.

**Hazard.** Stand, tree, and environmental characteristics that are conducive to an insect outbreak or disease infection (Doliner and Borden 1984). The term hazard is also used to describe a tree, or its parts, that could fail and injure or kill people (see: *danger tree*). Compare with: *susceptibility*. The Upper Touchet project includes design features addressing hazard trees in developed recreation sites, and danger trees located along roads and other travel routes.

**ICO (Individuals, Clumps, and Openings).** The ICO thinning "approach provides quantitative targets for spatial pattern based on historical or contemporary reference sites. Pattern is expressed in terms of the number of individual trees, and small, medium, and large tree clumps to leave in a stand (Churchill et al., 2013). Instead of marking for a specific range of basal areas, marking crews identify and track the number of clumps they retain while incorporating other leave tree criteria" (Franklin et al. 2013, p. 122). The specifics of ICO implementation are described in Churchill et al. (2013b). For the Upper Touchet project, ICO is considered to be a variant of the VDT with skips and gaps approach. See: *variable density thinning*.

**Indicator species**. Species used to monitor environmental change or represent specific environmental conditions (Eycott et al. 2007), including plant species conveying information about the ecological nature of a site, such as the nitrogen content, or the alkalinity or acidity of its soils. These plant species have a sufficiently consistent association with a specific environmental condition, or with other species, such that their presence can be used to indicate or predict the environmental condition, or a potential for the other species (Kimmins 1997).

**Intermediate cutting.** Any cutting method used in a stand between the time of its formation (seedling stage) and its regeneration as a mature stand. Commercial thinning, noncommercial thinning, and improvement cutting are three examples of intermediate cutting methods. The Upper Touchet project uses commercial and noncommercial thinning when modifying existing vegetation conditions on upland-forest sites, within certain class IV RHCAs, and in shrub-steppe environments.

**Irregular stand.** A stand of trees characterized by variation in age structure or in the spatial arrangement of trees; stands without a uniform age or size structure (Helms 1998). Analysis of historical inventory data collected from mature stands in 1910-1911 (Munger 1917) suggests that dry-forest stands had a structure closer to irregular than to classical even-aged or classical uneven-aged (Powell 1999).

**Keystone species**. Species with ecosystem effects that are disproportionately large in comparison to their biomass or number (Eycott et al. 2007). The gopher tortoise, for example, is a keystone species because more than 330 other species use its burrows (Simberloff 1999). A keystone species does not need to refer solely to an animal – for the Upper Touchet project, ponderosa pine is considered to be a keystone species for dry upland-forest biophysical environments.

**Ladder fuel.** See: *fuel*.

**Landscape.** A defined area irrespective of ownership or other artificial boundaries, such as a spatial mosaic of terrestrial and aquatic ecosystems, landforms, and plant communities, repeated in similar form throughout such a defined area (USDA Forest Service 2012).

**Landscape ecology.** A study of structure, function, and change in a heterogeneous land area composed of interacting ecosystems (Forman and Godron 1986). Some landscape ecologists classify the spatial elements of a landscape into three primary components:

**Matrix.** The most extensive and most connected landscape element; it plays a dominant role in landscape function. The matrix is the landscape element surrounding a patch. For the Upper Touchet project, 'matrix' is also used to refer to the main portion of a thinning unit where variable-density thinning will be applied – the skips and gaps portions of these thinning prescriptions are analogous to patches.

**Patch.** A nonlinear land area differing in appearance from its surroundings, which is typically the matrix. Patches are a landscape element distinct from the matrix and isolated from other similar areas (patches).

**Corridor.** A narrow, linear land feature differing from the matrix or a patch on either side. Riparian habitats along streams or rivers often function as corridors (Forman and Godron 1986).

**Layer (vegetation).** A structural component of a plant community consisting of plants of approximately the same height stature (e.g., tree, shrub, and herb layer); as defined here, synonymous with stratum (Jennings et al. 2003). For the Upper Touchet project, one objective of proposed upland-forest treatments is to convert some portion of multi-layered forest structures (such as the UR and OFMS structural stages) into the more historically appropriate (for dry sites) single-layer structures (such as SE and OFSS).

**Lifeform**. The structure, form, habits, and life history of an organism. In plants, characteristic life forms such as forest (trees), shrubs, and herbs (forbs/graminoids) are based on morphological features (physiognomy or predominant stature) that tend to be associated with different environments (Allaby 1998).

**Litter.** Dead debris (plant material) covering the ground, including cones, needles or other shed foliage, branches, and other material (Brenner 1998).

**Management area.** A land area identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous (USDA Forest Service 2012).

**Marking guides.** Marking guides are written direction, generally prepared by a certified or qualified silviculturist, to provide silvicultural guidelines or specifications for selecting trees to retain, or optionally trees to remove, in order to accomplish specific stand management objectives. Marking guides provide operational direction and guidelines to implement a detailed silvicultural prescription. They are written in such a way as to convey detailed specifications, and to clarify concepts and silvicultural terminology, related to why and how trees are selected and marked to implement a particular cutting method in a designated stand or treatment unit. For the Upper Touchet project, marking guides will typically vary by cutting method and treatment unit.

**Mastication.** This fuels treatment activity utilizes mechanical equipment to chunk, pulverize, or grind, and scatter, both natural and harvest-generated fuels so that resulting fuelbed conditions will meet objectives established for the Upper Touchet project.

**Mechanical treatment.** Mechanical treatment refers to the use of tractors or other machinery to remove trees in an operation to cut, clear, thin, girdle or prune woody plant species (Powell et al. 2001).

**Mitigation.** A near-term climate change strategy adopting tactics such as reducing greenhouse gas emissions (by reducing wildfire emissions, for example), or by enhancing carbon uptake and storage. Mitigation is sometimes considered to be analogous to resistance. Near-term mitigation and far-term adaptation are important strategies, in some combination, to address climate change. For the Upper Touchet project, both near-term mitigation and far-term adaptation actions are planned, as described in the climate change section of this report.

**Moist upland forest**. A potential vegetation group associated with biophysical environments where the climate, soil depth, and other physical site factors allow development of a tree-dominated ecosystem supporting vegetation types that are characteristic of relatively moderate or intermediate temperature conditions, and a moist or mesic moisture regime (Powell et al. 2007).

**Monitoring.** A systematic process of collecting information to evaluate effects of management actions, or changes in conditions or relationships (USDA Forest Service 2012).

**Native species.** An organism that historically, or currently, is present in a particular ecosystem as a result of natural migratory or evolutionary processes; it is not present as a result of accidental or deliberate introduction into the ecosystem.

**Natural fuel.** Combustible material resulting from natural processes and not directly generated or altered by land management practices (Helms 1998). Compare with: *activity fuel*. Also see: *fuel*.

**Natural regeneration.** The renewal of a forest community by natural (as compared to human) means, such as tree seedling establishment from seed on-site, from adjacent areas, or seed brought in by wind currents, birds, or animals.

**Nature.** This term has been used to mean the natural world on Earth as it exists without human beings or civilization, that is, the environment including mountains, plains, rivers, lakes, oceans, air, and rocks, along with all other nonhuman, non-domesticated, living things (Botkin 1990a).

**Noncommercial thinning.** A treatment in immature forests designed to reduce tree density and thereby improve growth of the residual trees, enhance forest health, or anticipate future mortality resulting from intertree competition. Noncommercial (also known as precommercial) thinning involves situations where trees being cut are too small to be sold for conventional wood products, so they are typically left on site by either lopping them into pieces and scattering the pieces close to the ground, or aggregating them into piles that are later burned (Powell et al. 2001). For the Upper Touchet project, noncommercial thinning is proposed for upland-forest sites, along some of the class IV RHCAs, and in shrub-steppe environments containing western juniper or ponderosa pine encroachment.

**Old forest.** A forest structural stage characterized by a predominance of large trees (> 21" dbh) in a stand with either one or multiple canopy layers. On warm dry sites that historically featured frequent, low-severity surface fires, a single stratum may be present containing 10 or more trees >21″ dbh per acre (old forest single stratum; OFSS). On cool moist sites where surface fire was relatively uncommon, multi-layer stands with at least 10 (or 20 for sites with higher productivity) large trees (> 21″ dbh) per acre in the uppermost stratum are typically found (old forest multi strata; OFMS). Compare with: *old growth*.

**Old growth.** Forest stands distinguished by old trees and related structural attributes such as tree size, accumulations of large dead woody material, number of canopy layers, species composition, and ecosystem function (Newton 2007). For national forest system lands in the Pacific Northwest, characteristics (attributes) of old-growth forests are described in USDA Forest Service (1993). Compare with: *old forest*.

**Outbreak.** A sudden increase in destructiveness or population level of a pest species in a given area; usually used in reference to bark beetles, defoliators, and other forest insects (Doliner and Borden 1984). For the Upper Touchet project, existing vegetation conditions reflect the influence of past outbreaks.

**Overstory.** For a stand of trees, overstory is the upper canopy layer; small trees established beneath the upper canopy layer are termed understory. Compare with: *understory; undergrowth*.

**Pathogen.** Any agent, whether a living organism or abiotic factor, that induces disease (Doliner and Borden 1984). For the Upper Touchet planning area, the primary pathogens of concern include Armillaria and annosus root diseases in dry and moist mixed-conifer forests.

**Physiognomy.** The growth form and structure (habit) of vegetation in natural communities (Allaby 1998, Dunster and Dunster 1996). The characteristic feature or appearance of a plant community or vegetation (Winthers et al. 2005).

**Physiognomic class.** Taxonomic categories or hierarchical units based on vegetation of similar physiognomy or life form, such as the upland forest, upland shrub and riparian herb physiognomic classes. Physiognomic class is the highest level in the midscale portion of the Blue Mountains potential vegetation hierarchy (Powell et al. 2007)..

**Plant association.** A plant community with similar physiognomy (form and structure) and floristics; commonly it is a climax community (Allaby 1998). It is believed that 1) the individual species in the association are, to some extent, adapted to each other; 2) the association is made up of species that have similar environmental requirements; and 3) the association has some degree of integration (Kimmins 1997). Also see: climax; seral stage: potential natural community.

**Plant association group (PAG).** Groupings of plant associations (and other potential vegetation types such as plant communities and plant community types) representing similar ecological environments, as defined by using temperature and moisture regimes (Powell et al. 2007). The most common PAG in the Dry Upland Forest PVG is the Warm Dry Upland Forest PAG.

**Plant community.** A naturally occurring assemblage of plant species living in a defined area or habitat (USDA Forest Service 2012). In a vegetation classification context: (1) a plant community has no particular successional (seral) status; (2) plant communities represent vegetation types with a restricted geographical distribution; and (3) plant communities have such a small number of sample plots that it is not possible to infer their true successional status (Johnson and Clausnitzer 1992).

**Plant community type.** An aggregation of all plant communities with similar structure and floristic composition. A vegetation classification unit with no particular successional status implied (Dunster and Dunster 1996).

**Plant succession.** The process by which a series of different plant communities, along with associated animals and microbes, successively occupy and replace each other over time in a particular ecosystem or landscape location following a disturbance event (Kimmins 1997). The process of development (or redevelopment) of an ecosystem over time (Botkin 1990a).

**Potential vegetation.** The vegetation that would become established if successional sequences were completed without interference by man or natural disturbance under present climatic and edaphic conditions; the plant community developing if all successional sequences were completed under existing site conditions (Dunster and Dunster 1996). Also see: climax; seral stage: potential natural community.

**Potential vegetation group (PVG).** An aggregation of plant association groups (PAGs) with similar environmental regimes and dominant plant species. Each PVG includes PAGs representing a similar temperature or moisture influence (Powell et al. 2007).

**Prescribed fire.** Deliberate burning of wildland fuels in either a natural or modified state, and under specified environmental conditions, in order to confine the fire to a predetermined area, and to produce a fireline intensity and rate of spread meeting land management objectives (Powell et al. 2001). For the Upper Touchet project, prescribed fire is an important management activity designed to manage tree-density levels (because prescribed fire mimics native surface fire, an important dry-forest thinning agent), maintain acceptable surface fuel loadings, and cycle ecosystem nutrients. For the Upper Touchet project, three specific types of prescribed fire will be used to help manage both natural and activity fuels:

**Jackpot burn.** A method for burning activity-created fuels in which only the larger fuel concentrations are ignited, and the resulting fire is confined to these locations.

**Pile burn.** A method for burning activity-created fuels that were first piled by using mechanical equipment, or by hand, with an objective of reducing fuel loading to prescribed levels.

**Underburn.** Application of prescribed burning in activity-created or natural fuels located beneath a tree canopy, usually with an objective of ensuring survival of dominant, overstory trees.

**Purpose and need statement.** In a NEPA context, this is a brief statement specifying the underlying purpose of a project, and the need to which an agency is responding (40 CFR 1502.13). The Upper Touchet project purpose and need focuses on reducing differences between existing and desired conditions pertaining to forest vegetation species composition, structure, density, fire regime condition class, and forest product availability.

**Range of variation.** A characterization of fluctuations in ecosystem conditions or processes over time; an analytical technique used to define the bounds of ecosystem behavior that remain relatively consistent through time (Morgan et al. 1994). Values of composition, structure, density or another attribute, and falling between upper and lower bounds determined for the attribute (Jennings et al. 2003), are said to be within the range of variation. Attributes whose values occur above the upper bound are said to be 'over-represented;' attributes whose values are below the lower bound are said to be 'under-represented.' Also see: *reference conditions*. For the Upper Touchet project, most of the forest vegetation desired conditions are characterized by using ranges of variation for species composition, forest structure, and stand density.

**Reference conditions.** A reference ecosystem or reference conditions can serve as a model for planning ecosystem restoration activities. In its simplest form, the reference is an actual site, its written description (such as historical accounts of a reference area), or both (SERI 2004). Reference conditions also refer to a range of variation in ecological structures and processes, reflecting recent evolutionary history and the dynamic interplay of biotic and abiotic factors. Reference conditions generally reflect ecosystem properties that are free of major influence by Euro-American humans (Kaufmann et al. 1994). For the Upper Touchet project, historical ranges of variation for species composition, forest structure, and stand density function as reference conditions in a forest vegetation context.

**Reforestation.** The restocking of an area with forest trees by either natural or artificial means, including out-planting of tree seedlings produced by a nursery. For the Upper Touchet project, reforestation activities are designed to introduce desired species into stands at a higher density than they might otherwise occur, but still remain within low or moderate levels in aggregate, at a stand-scale.

**Resilience.** Intrinsic properties allowing the fundamental functions of an ecosystem to persist in the presence of disturbance; the 'bounce-back' capability of a system to recover from disturbance. "Ecological resilience is the capacity of an ecosystem to absorb disturbance and undergo change while maintaining its essential functions, structures, identity, and feedbacks. Resilience is often synonymous with adaptive capacity, i.e., the ability of a system to reconfigure itself in the face of disturbance or stresses without significant decreases in critical aspects such as productivity or composition" (Drever et al. 2006). Resilience recognizes that systems have a capacity to absorb disturbance, but this capacity has limits and when they are exceeded, the system may rapidly transition to a different state or developmental trajectory (Gunderson et al. 2010). In a climate-change context, resilience is sometimes viewed as analogous to adaptation. For the Upper Touchet project, both near-term mitigation (resistance) and far-term adaptation (resilience) actions are planned, as described in the climate change section of this report.

**Resistance.** Resistance refers to the ability of an ecosystem to remain relatively unchanged in the face of external forces such as disturbance (pulse-type changes) or climate change. Resistance is sometimes viewed as being analogous to stability (Holling 1973), but in a climate-change context, it is often viewed as analogous to mitigation. For the Upper Touchet project, both near-term mitigation (resistance) and far-term adaptation (resilience) actions are planned, as described in the climate change section of this report.

**Restoration.** Restoration involves holistic actions taken to modify an ecosystem to achieve desired, healthy, and functioning conditions and processes. This term is generally used to refer to the process of enabling a system to resume acting, or continuing to act, following disturbance as if disturbance had not occurred (Powell et al. 2001). Restoration is a process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience, and health under current and future conditions (USDA Forest Service 2012). Two restoration approaches have been described:

**Active restoration.** An approach involving implementation of active management practices (prescribed fire, thinning, etc.) to restore appropriate composition, structure, or density conditions. For some areas of the Upper Touchet project, an active restoration paradigm is adopted – silvicultural activities are proposed to modify existing vegetation conditions and move them toward desired vegetation conditions.

**Passive restoration.** An approach involving removal of stressors causing ecosystem degradation, such as cessation of fire exclusion in fire-dependent ecosystems (Rapp 2002).

**Riparian areas.** Three-dimensional ecotones of interaction between terrestrial and aquatic ecosystems extending down into the groundwater, up above the canopy, outward across the floodplain, up nearby side-slopes draining to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths (USDA Forest Service 2012).

**Riparian forest**. A physiognomic class supporting a forest ecosystem, and occurring on riparian landforms or biophysical environments (Powell et al. 2007). See: *riparian areas*; *forest*. Compare with: *upland forest*.

**Riparian management zone (riparian habitat conservation areas; RHCAs).** Portions of a watershed where riparian-dependent resources receive primary emphasis, and for which plans include plan components to maintain or restore riparian functions and ecological functions (USDA Forest Service 2012).

**Risk.** A combination of the likelihood that a negative outcome will occur (as related to susceptibility and vulnerability), and severity of the resulting negative consequences (USDA Forest Service 2012). Note that risk refers to an event with a known occurrence probability, whereas uncertainty refers to an event with an unknown probability.

**Seral stage.** Identifiable stages in the development of a sere, from an initial pioneer stage, through various early and mid-seral stages, to late seral, subclimax, and climax stages. The stages are identified by different plant communities, different ages of the dominant vegetation, and by different microclimatic, soil, and forest conditions (Kimmins 1997). Four seral stages are recognized (Hall et al. 1995):

**Early Seral.** Clear dominance of early-seral species (western larch, ponderosa pine, lodgepole pine, etc.) is evident; PNC species are absent or present in very low numbers.

**Mid Seral.** PNC species are increasing in the forest composition as they actively colonize the site (or as they continue an ongoing developmental process); PNC species are approaching equal proportions with early- and mid-seral species.

**Late Seral.** PNC species are now dominant, but long-lived early- and mid-seral species (ponderosa pine, western larch, etc.) may still persist in the plant community.

**Potential Natural Community (PNC).** The biotic community that one presumes would be established and maintained over time under present environmental conditions; early- and mid-seral species are scarce or absent in the plant composition.

**Severity.** Proportion of the organic matter lost from the vegetation and surface soils due to disturbances (Chapin et al. 2002).

**Shade tolerance.** The capacity of trees to grow satisfactorily in the shade of, and in competition with, other trees (Helms 1998). Also see: *tolerance*. For the Upper Touchet planning area, the tree species with the greatest amount of shade tolerance are Douglas-fir and grand fir.

**Shrub-steppe.** Shrub-steppe ecosystems have been defined as plant “communities consisting of one or more layers of perennial grass above which there rises a conspicuous but discontinuous layer of shrubs” (Daubenmire 1970, p. 83). In the southeastern Washington and northeastern Oregon portions of the interior Columbia River basin, shrub-steppe plant communities often feature bitterbrush, big sagebrush, stiff sagebrush, or threetip sagebrush as primary shrub species, and bluebunch wheatgrass, Idaho fescue, basin wildrye, or Thurber’s needlegrass as common grass species (Daubenmire 1970, Franklin and Dyrness 1973).

**Silvicultural prescription.** A planned series of treatments designed to change current forest structure to one meeting the goals and objectives established for an area (Helms 1998). A prescription is a written statement or document defining the outcomes to be attained from silvicultural treatments; outcomes are generally expressed as acceptable ranges of the various indices being used to characterize forest development (Dunster and Dunster 1996). For the Upper Touchet project, silvicultural activities (treatments), including prescribed fire, will be directed by silvicultural prescriptions, marking guides, and burn plans. Prescriptions will typically vary by silvicultural activity (including cutting method) and treatment unit.

**Silvicultural treatment.** An activity, practice, or action that can be applied in a controlled manner, according to the specifications of a silvicultural prescription or forest plan, to improve actual or potential conditions or benefits (Hoffman et al. 1999). For the Upper Touchet project, the primary silvicultural treatments proposed for implementation include several types of commercial and noncommercial thinning, reforestation (tree planting), and prescribed fire.

**Silviculture.** Applying techniques or practices to manipulate forest vegetation by directing stand and tree development, and by creating or maintaining desired conditions. Silviculture is based on an ecosystem concept that emphasizes the need to evaluate the many abiotic and biotic factors influencing the choice and outcome of silvicultural treatments and their sequence over time, and the long-term consequences and sustainability of management regimes. [Definition derived from multiple sources.]

**Skip.** In forestry usage, skips include one or more portions of a stand, or a timber sale treatment unit, which are not to be entered during timber harvest activity. For the Upper Touchet Project, skips are used in association with variable-density thinning to conserve particular microhabitat conditions, provide visual breaks or barriers, contribute to wildlife habitat connectivity corridors, or provide protective cover for down-wood concentrations or snag patches (Franklin et al. 2013). Compare with: *gap*.

**Soil compaction.** The process by which soil grains or particles are rearranged, resulting in a decrease in void space and causing closer contact with one another, thereby increasing bulk density (Helms 1998).

**Species diversity.** Number, evenness, and composition of species in an ecosystem; the total range of biological attributes of all species present in an ecosystem (Chapin et al. 2002).

**Stewardship.** Taking a long-term and integrated view of resource management – air, water, land, plants, and animals – recognizing the dependent relationships of humans on the environment, and that environmental health is fundamental to economic and human health (British Columbia Habitat Branch 2000).

**Stewardship harvest.** Often, stewardship involves a tree harvest operation completed for reasons other than production of timber commodities (Powell et al. 2001). Stewardship harvest also includes situations where the timber volume to be removed by a silvicultural treatment is insufficient to cover treatment costs (logging, transportation, etc.), so a subsidy payment must be made (e.g., cash contributed) to make the project financially viable.

**Stressors.** Factors that may directly or indirectly degrade or impair ecosystem composition, structure, or ecological process in a manner that may impair its ecological integrity, such as an invasive species, loss of connectivity, or the disruption of a natural disturbance regime (USDA Forest Service 2012). For some portions within the Upper Touchet project vicinity, it is anticipated that climate change will function as an important future stressor, and the silvicultural activities proposed for implementation appropriately account for this eventuality.

**Structural stage.** A stage or recognizable condition that relates to the physical orientation and arrangement of vegetation; the size and arrangement (both vertical and horizontal) of trees and tree parts. The following structural stages have been described (O'Hara et al. 1996, Oliver and Larson 1996):

**Stand initiation.** One canopy stratum of seedlings and saplings is present; grasses, forbs, and shrubs typically coexist with the trees.

**Stem exclusion.** One canopy stratum comprised mostly of pole-sized trees (5-8.9″ in diameter) is present. The canopy layer may be open (*stem exclusion open canopy*) on sites where moisture is limiting, or closed (*stem exclusion closed canopy*) on sites where light is a limiting resource.

**Understory reinitiation.** Two canopy strata are present the size class of the uppermost stratum is typically small trees (9-20.9″ in diameter). In this stage, a second tree layer is established under an older overstory. Overstory mortality created growing space for the establishment of understory trees.

**Old forest.** A predominance of large trees (> 21″ in diameter) is present in a stand with one or more canopy strata. On warm dry sites with frequent, low-intensity fires, a single stratum may be present (old forest single stratum; OFSS). On cool moist sites without recurring underburns, multi-layer stands with large trees in the uppermost stratum may be present (old forest multi strata; OFMS). For the Upper Touchet project, silvicultural activities are proposed to convert some of the OFMS structural stage into the OFSS structural stage, which is historically more appropriate for dry-forest environments.

**Surface fire.** See: *fire*.

**Susceptibility.** This term refers to the probability of an organism being infected or infested by another organism (trees affected by bark beetles, defoliators, etc.), as evaluated by using inherent or intrinsic forest characteristics (species composition, stand density, etc.). The terms susceptibility and hazard are often used interchangeably. Compare with: *vulnerability*. For the Upper Touchet planning area, a forest vegetation situation of management concern is high potential for future uncharacteristic wildfire events, due primarily to overly dense stands having high crown-fire susceptibility, because this situation occurs in a portion of the Heppner Ranger District with high levels of recent wildfire activity (fig. 27).

**Sustainability.** The capacity of forests, ranging from stands to ecoregions, to maintain their health, productivity, diversity, and overall integrity, in the long run, and in the context of human activity and use (Helms 1998). The capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs (USDA Forest Service 2012). For the Upper Touchet project, silvicultural activities are designed to improve, and then maintain, the sustainability of forest vegetation resources, thereby fulfilling our important responsibility to act as a trustee of the Upper Touchet environment for succeeding generations.

**Sustainable forest management.** Active "management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social, and cultural opportunities for present and future generations" (Canadian Council of Forest Ministers 2008).

**Thinning.** A treatment designed to reduce tree density and thereby improve growth of the residual trees, enhance forest health, or recover potential mortality resulting from intertree competition. Two types of thinning are recognized – commercial thinning where the trees being removed are large enough to have economic value, and noncommercial thinning where trees are too small to be sold for conventional wood products, so the excess trees are cut and generally left on-site (Powell et al. 2001). For the Upper Touchet project, several types of commercial and noncommercial thinning are proposed for implementation (table 1).

**Timber harvest.** The removal of trees for wood fiber use and other multiple-use purposes (USDA Forest Service 2012). For the Upper Touchet project, timber harvest is proposed for situations where tree removal would contribute to attainment of desired conditions, and the trees to be removed have sufficient economic value to support a stewardship or timber-sale contract approach.

**Timber production.** The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (USDA Forest Service 2012).

**Tolerance.** A forestry term expressing the relative ability of a plant (tree) to complete its life history, from seedling to adult, under the cover of a forest canopy and while experiencing competition with other plants. In general ecology usage, tolerance refers to the capacity of an organism or biological process to subsist under a given set of environmental conditions. Note that the range of conditions under which an organism can subsist, representing its limits of tolerance, is termed its ecological amplitude (Helms 1998).

**Traditional ecological knowledge.** See: *native knowledge*.

**Undergrowth.** Herbaceous and shrubby plants growing beneath a forest canopy; as used in this report, undergrowth does not include small trees such as seedlings or saplings. Compare with: *understory*.

**Understory.** All of the vegetation growing under a forest overstory. In some applications, understory is only considered to be small trees (e.g., in a forest comprised of multiple canopy layers, the taller trees form the overstory, the shorter trees the understory); in other instances, understory is assumed to include herbaceous and shrubby plants in addition to trees. When understory is assumed to refer to trees only, other plants (herbs and shrubs) are often called an undergrowth to differentiate between the two (Helms 1998). Compare with: *undergrowth*.

**Uneven-aged stand.** A stand structure featuring trees of three or more distinct age classes (cohorts), occurring either as an intimate (intermingled) mixture or in small groups (Helms 1998). Reconstruction of historical stand structure for dry-forest sites suggests that these stands were typically uneven-aged, when evaluated at the stand level, but they tended to occur as assemblages of small, even-aged groups or clumps, with each group or clump generally occupying 0.6 acres or less (Powell 2014a).

**Upland.** Land that generally has a higher elevation than an adjacent alluvial plain, stream terrace, or riparian zone; or land above the foothill zone for a mountainous continuum (Dunster and Dunster 1996). For the Upper Touchet project, most of the silvicultural activities are proposed for implementation on upland sites.

**Upland forest.** A physiognomic class supporting a forest ecosystem, and occurring on upland landforms or biophysical environments (Powell et al. 2007). See: *upland*; *forest*. Compare with: *riparian forest*. For the Upper Touchet project, most of the silvicultural activities are proposed for implementation on upland-forest sites.

**Variable density thinning (VDT).** Variable-density thinning approaches are designed to emulate the natural variation resulting from small-scale canopy disturbances and competition-based tree mortality. VDT prescriptions often provide for unthinned areas (skips) and heavily-thinned patches (gaps), with intermediate levels of residual tree density prescribed for the remainder of the stand. This approach results in much greater spatial variability, structural complexity, and heterogeneity than is produced by typical intermediate stand treatments (Franklin et al. 2007).
For the Upper Touchet project, most of the commercial thinning treatments (table 1) will be implemented as variable-density thinning with skips and gaps, although some of these thinnings will utilize the individuals, clumps, and openings (ICO) variant of VDT. In my opinion, the VDT and ICO approaches proposed for implementation in the Upper Touchet project agree with dry-forest thinning recommendations offered by the conservation community (Brown 2002, Kerr 2007, Lillebo 2012).

**Vulnerability.** This term refers to the probability of tree or forest damage resulting from an infection or infestation by damaging agents (such as bark beetles, defoliators, etc.). Susceptibility reflects the influence of forest or stand conditions (are lodgepole pines in a stand larger than 9 inches in diameter, which renders them susceptible to bark-beetle attack?), whereas vulnerability relates to whether damage will actually occur (is a mountain pine beetle population in close proximity to a lodgepole pine forest containing susceptible trees?).
For the Upper Touchet planning area, the upland forest situation with the highest amount of perceived risk is potential for future uncharacteristic wildfire events, primarily because high-hazard conditions (overly dense stands with high crown-fire susceptibility) coincide with a highly vulnerable portion of the Heppner Ranger District, as evidenced by its recent wildfire activity (fig. 27).

**Watershed.** A region or land area drained by a single stream, river, or drainage network; a drainage basin (USDA Forest Service 2012). The Upper Touchet planning area consists of five contiguous and adjoining subwatersheds.

**Wildfire.** Any fire occurring on wildlands that is not meeting management objectives and thus merits a fire suppression response (Brenner 1998).

**Wildland-urban interface.** Areas where human communities are built in proximity to flammable fuels found in wildlands (Brenner 1998).

**Wood decay.** The decomposition of wood by fungi and other microorganisms, resulting in softening, progressive loss of strength and weight, and often changes in texture and color (Helms 1998). Terms associated with wood decay are provided below (unless noted otherwise, term definitions provided by the USDA Forest Service, Forest Products Laboratory).

**Bluestain.** A deep-seated fungal discoloration, predominantly bluish in color but sometimes grey, black or brown, confined mostly to the sapwood. Bluestain does not cause a loss of structural strength (Doliner and Borden 1984).

**Brown rot.** In wood, any decay in which the fungal attack concentrates on the cellulose and associated carbohydrates rather than on the lignin, which produces a light to dark brown friable residue known variously as 'dry rot' or 'cubical rot'.

**Heart rot.** Any rot or decay characteristically confined to the heartwood portion of a tree. Heart rot generally originates in the living tree (such as rust-red stringy rot caused by the Indian paint fungus).

**Incipient decay.** An early stage of tree decay that has not proceeded far enough to soften or otherwise perceptibly impair the hardness of wood. It is usually accompanied by a slight discoloration or bleaching of wood tissue.

**White rot.** In wood, any decay or rot attacking both the cellulose and the lignin, producing a generally whitish residue that may be spongy or stringy rot, or occur as pocket rot (advanced decay appearing in the form of a hole or pocket). White rot tends to produce more complete decomposition of the wood, and its decay products are much shorter lived (in the soil) than decay products produced by brown rots.